DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. IX. No. 103. JULY, 1928. PRICE 1s. NET

CAN WE FLY TO THE STARS?

CHIEF CONTENTS.

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Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Professor A. C. Seward, Sc.D., F.R.S., Professor R. S. Conway, Litt.D., F.B.A.

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Editorial Notes.

Recent weeks have been notable for the added interest given to aviation, first by the Pacific flight and secondly by the fortunes of the airship "Italia." It cannot be merely by chance that long-distance flights are becoming more sure of success, as every attempt affords its lessons in technique; but there was still a sensational element in the progress of the "Southern Cross," the first machine to fly the longest stretch of ocean which the map presents. The American airmen who last summer flew from New York to Tokyo in fourteen days were widely congratulated on stopping short at the Pacific, in a world flight, yet the improvements within so short an interval had been sufficient to justify the "Southern Cross" attempt. As with the less successful polar flight of the "Italia," this was undertaken in a serious spirit, and we hope that both achievements will now deter the mere sensation seekers. Spectacular Atlantic attempts seem likely to become a regular summer feature, and as we go to press there is evidence that this mania is beginning once more. Credit may perhaps be given to Miss Earhart, the first woman to make a successful crossing, though it appears that her share was mainly that of a passenger. The time has come for public opinion to insist on some measure of control.

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At the time of writing a number of rescue expeditions are preparing to go to Spitzbergen, where the "Italia" survivors are stranded fifty miles from North-East Island. In Sir Hubert Wilkins' opinion it is unfortunate that none of the party had had the advantage of living with the Eskimos and learning their ways of hunting. This remark may well serve to emphasize that his own success in flying across the Arctic a few weeks previously was anything but the outcome of chance. Reading between the lines of his Press comments on the "Italia's" troubles, some of the conditions with which Sir Hubert had to contend himself become apparent. When he called at our offices a few days ago, we were much impressed by the modest personality of this great explorer-airman, and we may perhaps be allowed to express the congratulations of *Discovery* on the honour which the King has bestowed.

* * * * *

One other flying development calls for remark. We publish on another page the plans of a German inventor, Herr Max Valier, who is now on surer ground than a year ago when he first advocated rocket flying. The first motor-car propelled on this principle has been successfully tested in Berlin, as the result of which the power obtained and other practical factors are now known. The theoretical aspects of flying outside the earth's atmosphere were fully discussed last year in *Discovery*, and we shall await with interest the next stage in the project.

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We remarked recently in lighter vein on the work of the Princeton Mission in Peking, where a wall had been built round Yenching University to prevent the activities of marauding war-lords. From the same source we have now received a cutting from the New York *Sun*, in which Dr. J. Leighton Stuart discusses the new Japanese attack on Shantung. This American observer, who was born in China, the son of a missionary, and is president of Yenching University, says that this attack has a deeper significance than a mere incident in the age-old racial conflict of the East. Japan, it appears, is confronted by a birth rate increasing her population 700,000

a year. She has tried colonization, but Canada, Australia and America are closed to her emigrants, and in Formosa and Korea, where she established colonies, the standard of living was too low. Unable to adjust themselves, the Japanese colonists became discouraged and returned home. Another solution offered itself—the industrialization of Japan. To accomplish this she had to develop in China sources of raw materials, and a market, and this process has been going on for a number of years. Now the Nationalist forces, moving northward toward Peking, have cut the Shantung railway and threatened in a single stroke the movement of raw materials to Japan and the chief line of communication to her market. An imperialistic Cabinet is in power in Japan. "Their normal reaction was to save the Shantung railway at all costs," Dr. Stuart remarks, "but it seems to me that in saving the Shantung railway they may lose all China."

* * * * *

The only power in China to-day, we are told, is public opinion. Japan easily can dominate a section of the country such as Shantung, but she is liable to run into a nation-wide boycott of Japanese goods. The Japanese have awakened the only force that can be used against them, boycott being a weapon that China knows how to use with telling effect. Once before the nation was aroused to boycott the products of Japan: students visited the shop-keepers and argued long and earnestly against handling Japanese goods, and where the merchants refused, their shops were looted and the hated merchandise destroyed. During this period the Chinese guests of Dr. Stuart refused to drink tea out of cups made in Japan. Whether the North and South of China will be unified as a result of Japan's aggressive tactics in Shantung—an effect by no means unlikely—Dr. Stuart is sure of one result. Within a few months Japan's trade will dwindle and her largest market will be alienated.

* * * * *

The solution in Dr. Stuart's judgment will be found in watching Japan, for we shall soon see whether the aggressive policy of her imperialistic Cabinet has the support of the people. The industrial districts already have expressed their disapproval, and if this sentiment grows it is possible that the Cabinet will be forced to resign and a more liberal government take its place. China is in a stage of metamorphosis, and from the old loyalties toward ancestors and family, she is turning to a national consciousness and a sense of public welfare. The change is not an easy one, for it strikes at the root of tradition and race psychology, but toward this end the position in Shantung may eventually prove a powerful force. For this reason we select the incident to give the foregoing views, which, coming from one so impartial and well-informed as Dr. Stuart, provide a new clue to the Chinese puzzle.

* * * * *

Until quite lately the exact nature of luminescence in certain marine animals was not known. It is now discovered to depend on one of those phenomena in nature which Professor MacKinnon, in a lecture at the Royal Institution, appropriately calls "Life's unexpected partnerships." Within the animal's body there are captive bacteria having the power to emit light, which in the cuttle-fishes, for example, live in the cavity of the so-called accessory nidamental glands. In these animals there are elaborate devices for insuring that the developing young receive their bacterial supply from the parent. The advantage gained by the cuttle-fish is probably related with bringing the males and females together at the time of mating, but it is not yet obvious what special advantage accrues to the bacterial partner. The majority of the other known associations of the kind have probably to do with food-capture and with its digestion, but in all the most recently described examples, while symbiosis is suspected, it has not been scientifically proved. It has still to be shown experimentally that the host cannot get on without its guests.

* * * * *

A new appeal has been issued by the British School of Archaeology in Jerusalem, of which Sir Frederic Kenyon is President. The school was founded in 1919 to provide instruction for students, and training for excavators and inspectors of antiquities. For many years, British explorers have taken a leading part in the rediscovery of ancient sites in Palestine, and the interpretation of Hebrew and early Christian history. Under the Mandate from the League of Nations for the Government of Palestine, while Great Britain is responsible for the custody of all ancient remains, facilities for archaeological exploration are open to all nations: there are already American, French and German institutes for the reception of students and travellers, and for the conduct of excavations. It would be a disaster and a disgrace if British scholars were compelled to depend on foreign institutions for the necessary facilities for their studies, and if the operations of the Palestine Exploration Fund and other British societies were hampered by lack of a working centre in Jerusalem. To maintain the school on its present modest establishment, an annual expenditure of at least £1,150 is necessary, and we commend the work for generous support.

Recent Excavations at Cyrene.

Ey Luigi Pernier.

Professor of Archaeology in the University of Florence.

The first excavations at Cyrene were carried out by British officers in 1860-61. Work was resumed in 1910 by an American expedition, and after the Italian occupation of Tripoli it was continued by the authorities. Since 1925 special encouragement has been given, and a first article by Professor Pernier here describes the main discoveries to the end of the 1926 season.

THE Fountain of Apollo at Cyrene, which attracted the original Greek colonists to this north African site in 630 B.C., rises from a subterranean channel about three hundred yards long and a yard high. This was investigated for a short distance only by explorers in the past century, P. della Cella, the Beechey brothers and Porcher. The name of the latter appears among the inscriptions which cover the wall of the subterranean passage, followed by H.M.S. "Assurance," the name of the vessel used for transporting to London the statues discovered in Cyrene by Smith and Porcher in 1861. G. G. Porro in 1913, and, with greater thoroughness, G. Oliverio in 1916, explored the narrow canal as far as its inner opening, beyond which it is impossible to penetrate, and Oliverio, after surmounting great difficulties, succeeded in making drawings and photographs which revealed the interior.

THE NORTH-EAST HILL OF CYRENE.
View showing the general character of the site. The eastern part of the excavations, in the foreground, includes the *Thermae*.

This canal is composed of two parts. The exterior and most ancient constitutes the Fountain of Apollo (celebrated by Pindar and by Callimachus), which was the cause of the founding of Cyrene on that day when the colonists from Thera, guided by the Libyans, halted before the copious stream of its fresh and limpid water. The interior was afterwards artificially constructed, corresponding with the Sacred Grotto of the Nymphs (*Nymphaeum*), and it was here that the walls and vault bore inscriptions, some incised in the softer layers, others in relief produced by the application of small rods or reeds of clay on the rock. There is reason to believe that sacrifices were offered in the grotto, near the spring, and the ancient inscriptions, dated with the name of the Emperor or the Priest of Apollo, mention priests who entered the precincts for liturgical purposes and pilgrims who came to register the successful accomplishment of their vows.

Most important finds are two striking Greek inscriptions. One of these, called "the Stele of Augustus," is cut into a block of marble, measuring two yards in height, about three-quarters of a yard in breadth at the base, and half a yard at the top, and comprises 144 lines of minute writing. This block must have stood originally in a prominent position in the Graeco-Roman Agorà, which lies on the elevated plain in the south-western part of Cyrene; later, it was placed on one side to serve as a seat in an edifice also in the Agorà; and to the fact that the inscription was concealed by being turned to the wall, we owe its remarkable preservation. The inscription consists of two parts: the former includes four edicts of the Emperor Augustus in the year 7-6 B.C., relating to the judicial and financial administration of the Province and also to several Roman citizens, residing in Cyrene, and placed under surveillance for suspected political tendencies. The second is the text of a message from the same Emperor, who, in the year 4 B.C., communicated to the inhabitants of Cyrene a senatorial proposal, initiated by the Consuls for that year, G. Calvisius Sabinus and L. Passienus Rufus, for the protection of the colonists from the violence and rapacity of the public officials.

"This proclamation," writes Augustus, "is issued for the purpose of assuring the inhabitants of the Provinces that I and the noble Senate will provide for the safety of those entrusted to us, allowing them to suffer neither molestation nor spoliation."

The importance of this inscription in regard to the juridical and political decrees of Rome is equalled by the value of the second inscription in the field of Hellenic religious documents. This second incised block had also been employed as a seat in a large room of the *Thermae* which the Byzantines had reconstructed along the eastern side of the Sanctuary of Apollo, below the Fountain of the same name. The Byzantine stucco fortunately served to protect the inscriptions which were cut upon three sides; the central and the left columns contain documents of Delphic law and ritual; in the right column are recorded the names of forty-three cities of Greece and of two queens, Olympia of Epirus and Cleopatra of Macedonia, who during a famine which lasted for five years (336-330 B.C.) received about 29,000 tons of grain from Cyrenaica. This is an impressive and incontestable proof of the agricultural capacity of that region. Silvio Ferri discovered this precious block in 1922, with other blocks of marble also bearing inscriptions, one of which has preserved the constitutional tables of the Cyrenaic Republic. The inscription of the Delphic Laws may be referred to the last decades of the IVth century B.C. A kind of religious codex, it transcribes and collects Delphic responses and ancient racial memorials, relying chiefly upon oral traditions and still earlier inscriptions. The responses are largely composed of ritual prescriptions for obtaining purification after contamination, even when involuntary, and often refer to suppliants who were seeking release either from pecuniary debts or from the crime of shedding of blood.

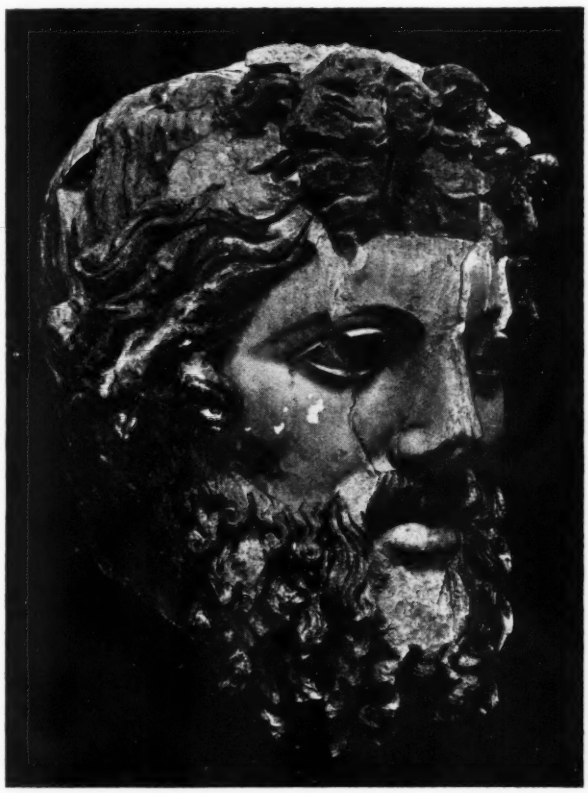
Just as in the writings of Pindar and Callimachus we find frequent mention of personages and places of Hellenic Cyrene, so these inscriptions abound in allusions to local topography; the Agorà, within the precincts of which Pindar placed the tomb of the first King of Cyrene, is the one where the Stele of Augustus was erected; the regulations for purification, noted in the *Lex Cathartica*, were performed in the temples and on the altars which were seen by Pindar and Callimachus. One of the paragraphs of this law commands "the recent bride to descend into the *Nymphaeum* of Artemis during the Artemisian festivals"; adding, "Let it be as soon as possible." Another inscription records the release from his oath of Lysimachus, son of Lysimachus, directly after the celebration of the Artemisian ceremonies. This actual temple, the Altar of Artemis, and the subterranean *nymphaeum*, have all been brought to light near the temple and the Altar of Apollo.

The monuments thus discovered in Cyrene give the solid basis of truth to the records preserved by the inscriptions, and the latter, together with the literary traditions and with the statues, enable us to rehabilitate the silent ruins and to people them with the personages of ancient days. Although conducted with praiseworthy zeal, the excavations have thus far revealed but a small part of the vast city once girdled by a wall with turrets and a zone of cemeteries more grandiose than in any other city of Greece and perhaps of the classical world. The general topography, however, as suspected by H. Weld-Blundell in 1895, and as shown by its most vital arteries, is as follows: On the hill to the south-west we have the *Forum* and the *Acropolis*; on the eastern side of the Acropolis, cut through the solid rock, the highway of which Pindar speaks as "resounding with the tramp of horses" (referring no doubt to the sacred processions), descending from the Agorà to the Fountain of Apollo; in front of the latter, extending in a

A HEADLESS FEMALE STATUE.
This marble statue is of the type of Artemisia, and was found in the area between the Sanctuary of Apollo and the Theatre at Cyrene

northerly direction, the terrace with the Sanctuary of Apollo, and towards the west the Theatre.

On the hill to the north-east stood the great Doric Temple of Jupiter, in which was found an admirable head, probably a copy of the master-piece of Pheidias, but executed in reduced proportions during the period of the Antonines. This image of the Supreme Deity, with its gilding and with the shining ivory-like polish of the marble, shows an imitation of the chryselephantine technique of the great original at Olympia, and also resembles the heads of Jupiter on the gold staters coined by the Sacred Mint of that city in the Vth-IVth century B.C.



MARBLE HEAD OF ZEUS.

Unearthed in the *Olympieion* at Cyrene, this marble head is a replica of the Olympian Zeus of Pheidias. The piece is noteworthy for its excellent state of preservation.

The excavations between the years 1913 and 1924 were devoted to bringing to light and illustrating the Roman monuments of the Agorà and the sanctuary, only in some cases reaching the Hellenic strata. In order to make a complete excavation of the stratification and to trace the history of the monuments from the foundation of Cyrene (about 630 B.C.) up to the Byzantine period, the Ministry of the Colonies and the Government of Cyrenaica in 1925 instituted a special mission.

First comes the Temple of Apollo, identified by Smith and Porcher in 1861, which has now been completely excavated so that the various stages of its history for eleven centuries are revealed. The temple, of the archaic Doric order, was enclosed by six frontal and eleven lateral columns with a prolonged cella and interior recess (*adytum*), each divided into three aisles by two rows of seven columns and with subterranean chambers for the preservation of the treasure. By its arrangement and structure this temple resembles the most venerated fane of primitive Greece, the Temple of Hera at Olympia, and also recalls important characteristics of the architecture of the Mycenaean palaces. The *adytum*, a sacred enclosure inaccessible to the laity, which in the Temple of Apollo at Delphi we find reserved for the exclusive use of the Pythia, confirms the deduction of Ferri from a passage in the Delphic ritual of Cyrene, that in this temple also oracular responses were made.

When the building became dilapidated from age—a natural consequence when we remember that the walls were constructed of crude bricks, the wooden covering adorned with ornaments of terra cotta and the columns composed of painted tufa—the Romans, having created a new province of Crete and Cyrene, wished to give renewed splendour to the city, and set about the work of enlargement and renovation. They renewed from its foundations the base of the peristyle, increasing its size and raising it upon three high steps with new and heavier Doric columns. The remains of the primitive peristyle were buried, but the ancient cella (of which part of the brick walls and the internal columns were left), was surrounded by walls constructed of blocks of tufa and placed in communication with the raised peristyle by means of a broad staircase.

We read in the inscriptions that during the insurrection of the Jews ("*tumultus iudaicus*") of A.D. 115-16 the edifices of the sanctuary were destroyed and burned; later the restoration was ordered by Hadrian; the Temple of Apollo met with a similar fate, and the inscriptions further record that, under Commodus, Decimus Cascellius Aristoteles initiated the renovation of the cella. In the following period priests and private individuals gradually rebuilt the exterior colonnade.

In A.D. 394 a violent earthquake overthrew the temple, causing it to fall upon the surrounding buildings and reducing the sanctuary to a mass of ruins, in the midst of which the Byzantines erected a small church and a bath-house, employing for this the existent marbles, even when inscribed, which had served for the altar and for votive inscriptions.

The northern limit of the sanctuary is formed by a high wall of about 400 metres in length for the support of the artificial esplanade; on the eastern confines the latest excavations disclosed a Hellenic gateway and a *propylaeum* of the Roman Imperial time, and it is intended to continue in a southerly direction from the latter point towards the Fountain of Apollo, following broad existent stairways, and also to the west, towards the theatre. The sacred precincts, however, comprising the area between the *Apollonium* and the *Thermae* in the eastern zone have now been cleared as far as the Hellenic pavement. From the Roman *Propylaeum* where the tetrastyle façade is now being restored, the visitor may at present proceed along the ancient Sacred Way. Immediately on his left he will perceive a graceful Greek fountain ornamented with Doric half columns and four spouts, once adorned with lion's heads. A little further are the *Plutonium*, including the Temple of Pluto, of whom there was found a figure in tufa with the head and extremities in marble; the Temple of Proserpine, where the divinity was represented in a beautiful Roman statue of marble, copied from an Hellenic original of the end of the Vth century B.C.; and a chapel of Serapis, in which was discovered a fine statuette of that god seated on a capacious throne, possibly an imitation of the famous statue made by Bryaxis for Alexandria.

Turning towards the north-west, the Via Sacra leaves on the right another temple of most ancient origin and passes between the enclosure of Artemis and the great Altar of Apollo, which latter measures twenty-three metres in length. On the northern side of the altar is cut in the large fine characters of the IVth century B.C.: "Philon, son of Annikeris, dedicated the altar, the one of Parian marble." Before Philon undertook the work of facing with marble the three steps and carving the table and sides with fine ornamentation in the style of the Erechtheum, the altar had been a simple construction in blocks of tufa of the same age and appearance as the base of the primitive Temple of Apollo. We found only the lower portion of the tufa altar; the marbles of Philon had been removed by the Byzantines for the paving of their baths. These facts having been ascertained, we restored to the altar its marble ornamentation, scrupulously fitting each piece into its original place; and now we may behold the splendid precedent set by the wealthy Greek of Cyrene to his descendants who have embellished modern Athens.

THE GREAT ALTAR OF APOLLO.

This altar was refaced in the IVth century B.C. by Philon, and measures over twenty yards in length. The marble facing, removed in the Byzantine age to floor a bath, has now been replaced.

In the immediate vicinity of the Altar and of the Temple of Apollo, worshipped under the title of Carneius, was a continuous series of sacred monuments, intermingled with staircases and fountains. Exactly to the south of the altar stood the temple dedicated by T. Claudius Jason Magnus to Apollo Ktistes; proceeding westward we observe a column in the form of the silphium stem (the emblem of Cyrene), dedicated by Pratomedes; a circular *nymphaeum*; the Temple of Apollo Nymphagetes; a second fountain, and an oratory to Isis. Of the numberless offerings the majority are statues; the spade has unearthed not only numerous bases with the names of those who dedicated them, but many rare and valuable objects, such as a rough statuette of a Maiden (Kora) in iron, a unique proof of the use of iron for primitive Hellenic statuary, and a small bronze head which portrays in the exquisite original art of the Vth century B.C. the grave and noble lineaments and expression of a victor, crowned after the sacred contests.

The Temple of Artemis (of as ancient date as the *Apollonium*), enlarged and embellished by the Romans, has also its majestic primitive altar of tufa as well as its depository for the gifts, and its treasure with votive offerings. These consisted of small vases, lamps, and statuettes of terra cotta and an infinite variety of minute objects in stone or precious metals such as pendants, necklaces, ear-rings, and diadems, offered by the ladies of Cyrene in religious fervour or in

expiation of peccadillos not included among the penitential offences. The subterranean *nymphaeum* to which the women descended for the rites of purification, according to the prescriptions of the Law, has been discovered at the north-east corner of the *Artemisium*, below the Temple of Artemis Infera, of whom we have also found the threefold image in painted tufa.

To the north and west, that is, along the retaining wall and towards the theatre, other sanctuaries, porticoes and depositories for offerings give the ruins of the terrace a number and variety of monuments that may be compared only with the sanctuaries of Delos, Delphi and Olympia. Cyrene may even vie in grandeur with Pergamum when the excavations have been continued to the Acropolis and to the city beyond the *Forum*, where already have been brought to light the chief roads, the Capitol, the State Archives (the *Tabularium*), the Temple of Ceres with the inscription of the prices of vegetables, the great Portico dedicated to Jupiter the Saviour, Roma and Augustus, and the spacious altars to the Divinities of the Agorà.

THE SANCTUARIES OF APOLLO AND ARTEMIS.
In the vicinity of the Altar of Apollo and of the Temple of Artemis was a series of sacred monuments, with staircases and fountains. When excavations have been completed, the whole scene may vie in grandeur with Pergamum.

"On the boundary of the Agorà lies Aristoteles Battus, the first king, revered as a hero," sang Pindar in his Vth Pythian Ode. It is not surprising that such an honour should have been paid the founder of the glory of Cyrene, who in obedience to the words of the oracle, had safely guided thither the colonists from the island of Thera; but what explorer would have dared to hope for the discovery of his mythical burial-place? As the Tomb of Romulus has emerged from the ruins of the Forum Romanum, so we believe we have discovered in the Agorà of Cyrene the sepulchre of Battus—a small round structure on the boundary of the Agorà in an area which still preserves indubitable traces of having been used for religious observances. In this, as in many other instances, scientific excavation has proved the authenticity of what were once considered legends or the creations of fancy.

REFERENCE:—Volume IV of the archaeological reports of the Italian Ministry of Colonies (published in Rome by Alfieri & Co.) contains 39 plates illustrating the Cyrene excavations conducted under its auspices.

A New Maya Treasure.

A TURQUOISE mosaic recently discovered in the Temple of the Warriors at Chichen Itzá, Yucatan, is claimed to be among the finest known examples of aboriginal American art. It is the first to be found within the Maya area and in a recognized and datable archaeological horizon. From the preliminary excavations described in *Discovery* last January it will be recalled that the Temple of the Warriors was found to be the last of three structures erected on the same site. The new treasure is the outcome of further digging by the Carnegie Institution expedition, and it was unearthed in the inner chamber of an earlier buried temple. A systematic search had been made wherever there were traces of altars for ceremonial treasure, and in the inner chamber a specimen was at last revealed in unexpected circumstances. The floor below the area assumed to have been covered by the altar tables, which had been removed, was cut into without success, when near the wall of the chamber the pick happened to touch an object unlike the floor materials. Presently a buried vessel was exposed, in which the mosaic was discovered.

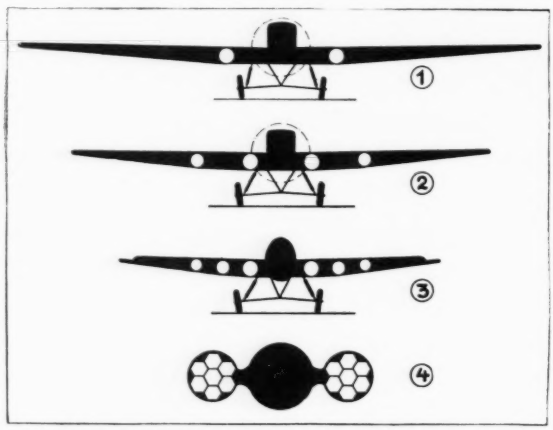
Most of the cut pieces are highly polished, and on them were found placed the bones of a bird, the component parts of a necklace, and a highly polished ball of jadeite—a symbol used by the Maya priests for divination purposes. The plaque is between eight and nine inches in diameter, but the wooden body has completely decayed, with the result that the mosaic is held in place only by the paper-thin film of adhesive matter by which the pieces were encrusted upon the wood. Two-thirds of the mosaic is relatively intact, and the rest is sufficiently related to permit restoration. In addition to an elaborate arrangement of petal-shaped divisions, enclosed by a stripe of brilliant red lacquer, the pattern embodies the head and claw of a reptilian creature, and consists of 3,500 pieces of turquoise. Restoration is now being undertaken by an expert from the New York Museum of Natural History, who has travelled specially to Yucatan for this unusually delicate task.

Can We Fly to the Stars?

By Max Valier.

The inventor of the rocket car that was successfully tried out a few weeks ago in Germany, here discusses the test, and outlines proposed flying developments. In translating Herr Valier's manuscript we have appended some Press comments on the problem, including the announcement of a five thousand francs annual prize.

PRACTICAL tests have now proved the possibility of propulsion by the rocket-principle engine. For several years the author has been trying to explain to a sceptical world how flight beyond present-day limitations may become possible.* He claims that the rocket-principle engine can be so far developed that it will outshine all other engines, from the point of view of high power with minimum weight. And now, on the Opel motor racing track at Ruessenheim, near Berlin, a test has been made with a motor-car fitted with a rocket-tube engine embodying the author's principles. The result shows that not only can enormous speeds be obtained, but also that the machine is under complete control. This last point is most important.



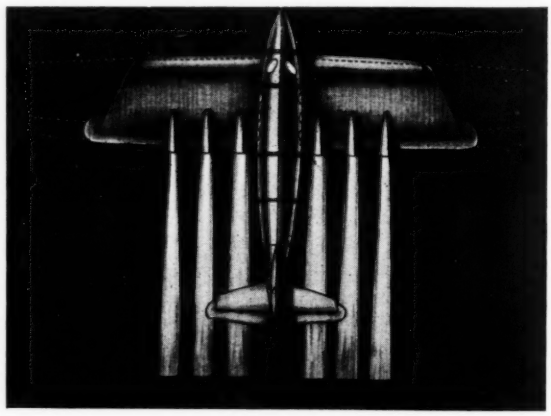
PROPOSED EVOLUTION OF THE ROCKET SHIP.

In these four stages are seen a standard aeroplane carrying two rockets and auxiliary propeller, evolving finally to a wingless torpedo with fourteen ejectors.

When the rocket car was started up, with its series of rocket tubes protruding from the rear like a battery of light guns, it shot off the mark with a tremendous explosion. Within seven seconds it attained a speed of approximately 100 kilometres per hour, a speed which it nearly doubled during the run. As it dashed by the spectators' stands it was feared that the car would run out of control, and there was relief when, at the curve, the driver shut off the engine, turned, and restarted the rocket batteries, on coming into the straight again. Eventually the machine was pulled up "dead."

To test the power of rockets, a further experiment was carried out on the Opel racing track. A hugh rocket prepared by Herr Sander, the life-saving apparatus expert, was erected on a long pole, like a slender telegraph pole, which acted as "stick." The size can be judged from the fact that it took six men to erect it. When fired the rocket sped heavenwards at a speed calculated at 1,000 kilometres per hour, and disappeared across the sky, pole and all, as a thin black streak.

The next step is to build a rocket-propelled car of more special design, with which to attempt speed records. This will lead to the aeroplane fitted with auxiliary rocket tubes for high flying. The height records will be attempted with a view to getting experience of how the apparatus, and especially the human driver, are effected by the thinner air and excessive cold of the upper regions of the atmosphere. It is realized, of course, that the airmen must be protected against these conditions by artificial "equalizing" means. Step by step the wings of the machines in successive experiments will be reduced and the rocket tubes increased in size or number,



THE THIRD STAGE.

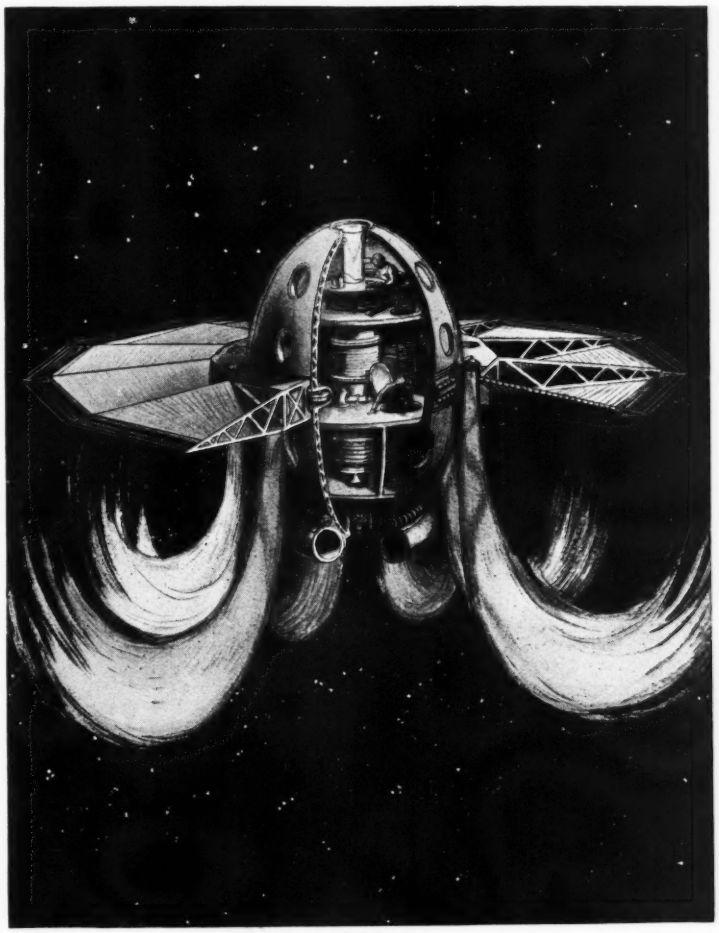
At this stage the aeroplane will no longer employ a propeller and will be constructed with shorter wings and streamline body.

* The first English article was published in *Discovery*: "Europe—America in Two Hours?" 1927, p. 187.

until the machine resolves itself into a huge air torpedo propelled by the gas molecules of the exhaust.

As was remarked in the previous article in *Discovery*, the objection has been raised that voluntary movement and steering of a rocket ship would be impossible in the empty space beyond the earth's atmosphere, because the motor of the ship would find no resistance for its power development. In travelling through the atmosphere, however, the rocket does not rely on the support of the air, but moves by its own internal energy through it. The space-ship likewise would move forward by means of the expulsion through the exhaust nozzle of the exploded gas, whereby a continuous recoil—similar to that momentarily occurring when a gun is fired—would exist to drive the ship onward.

We have still to wait patiently for actual achievement in these directions. The author and the Opel engineers have shown that rockets can drive a car, but of "space," actual void or even the thinner strata of the earth's atmosphere, we know nothing. There may be many things to contend with which have not yet been thought of. And what of the human heart? Strange things happen in the human frame in artificial conditions. Shall we have to evolve a new race of men?



A SPACE SHIP BOUND FOR MARS!

The imagination of the artist is here untrammelled by scientific considerations, and his glimpse of the future is reminiscent of Jules Verne. The leisured demeanour of the aviators in the cabin, suggests that the exterior of the ship is designed to revolve independently as it whirls on its way to Mars.

In connection with the rocket car test, a statement as to flying developments was made by Herr Fritz von Opel, the head of the motor firm which built the machine. As reported in *The Times*, he said that aviation was still "labouring through the murky realms of the earth's atmosphere, while a few miles higher regions offering less resistance and better weather held out the possibility of ten times greater speeds." These regions had remained unexplored because the combustion engine needed a supply of air which they did not provide. It was necessary to find a motive force which could dispense with air, and they believed they had found this in the rocket. The test performance vindicated the principle and concluded the first stage of their programme. The next steps, he predicted, would be divided into six stages:—

(1) An attempt upon the world's speed record, in order to show that all previous speeds could be surpassed.

(2) The construction of the rocket aeroplane.

(3) The exploration of high altitudes; recording instruments would be "rocketed" to hitherto unknown heights. Animals would also be sent up in order to ascertain whether, in addition to the known but surmountable difficulties of temperature, pressure, and lack of oxygen, other dangers existed in the unexplored altitudes.

(4) A "manned rocket"; the problems of the supportable pressure at the moment of "firing" and the security of the airtight "passenger chamber" would be progressively approached.

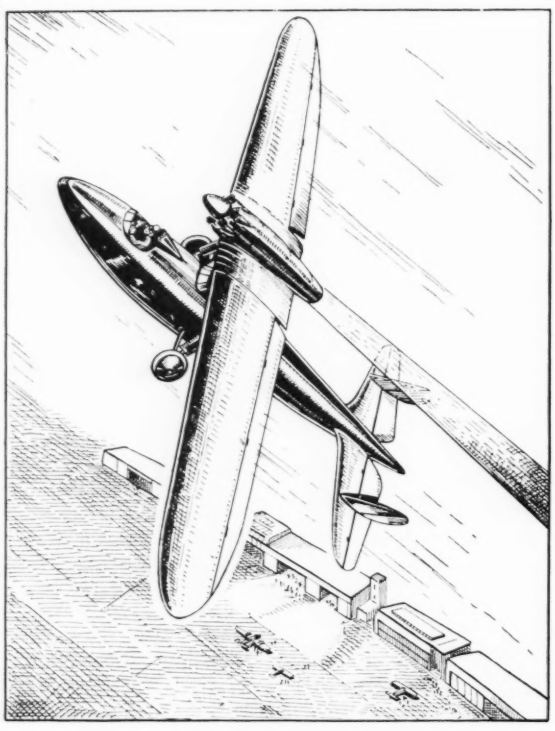
(5) The building of aeroplanes suitable for flights

in altitudes between twenty and thirty kilometres (about twelve and eighteen miles); speeds of above 1,000 kilometres (625 miles) an hour are expected. A world flight in less than half a day should prove to be possible.

(6) Efforts to reach ever-increasing speeds and altitudes; as to the possibility of reaching neighbouring worlds, there was no need to waste thought upon such ideas just yet, Herr Opel concluded.

It appears, however, that the problem of flying to the stars is already attracting attention in France, where it is popularly called "astronautics." According to a report in the Philadelphia *Public Ledger*, M. Peletrie, who made his reputation twenty years ago as a designer of light engines and streamline airplanes, is offering through the Société Astronomique an annual prize of 5,000 francs for the best essay upon astronautics.

That the creating of the essay prize is no idle gesture is proved by the fact that in scientific circles there is a "school" of astronauts. Peletrie is the founder, and as many as fifteen years ago he made first mathematical investigations of interplanetary travel.



A SINGLE ROCKET MACHINE.

In an early stage experiment in rocket flying the aeroplane might be fitted with a single battery of rockets, in place of the usual petrol engine.

Darwin To-day.

So many discoveries have been made in biology during the seventy years since the publication of "The Origin of Species," that the idea is commonly held that Darwin's original theory is now largely out of date. The greatest interest therefore attaches to an introduction Sir Arthur Keith has contributed to a new Everyman Library edition (Dent, 2*s*.), which in ten pages provides a modern commentary by one whose knowledge of the subject is unsurpassed. It is important to know the alterations which Darwin found it necessary to introduce in successive editions, hence Sir Arthur gives a list of these in the opening pages, but Why, he asks, should so many critics continue to misunderstand the essentials of Darwin's theory of evolution?

The truth is that Darwin himself was at fault, in amplifying the title of his theory with the words "By means of Natural Selection." Plainly this was a misnomer, as Darwin placed in a most conspicuous position, at the end of his introduction, the qualification that "natural selection has been the main but *not the exclusive* means of modification." Darwin perceived that another main factor is concerned in evolution, the "productive" factor, which gives rise to the materials of evolution—the points or characters wherein one individual differs from another. As to how such "variations" are produced, every chapter of his book finds Darwin declaring that he does not know. The only point of which he felt certain was that individual differences do not arise by chance.

Every year modern biology is learning more and more concerning the production of variations, which are regulated by an extremely complicated series of interacting processes; but nevertheless Darwin had wisely made full allowance for the ignorance of his time and for future knowledge. "What we discover now and what our successors will find out . . . will serve to add fuel to the fire kindled by Darwin: further discoveries cannot extinguish that fire. Our knowledge of the laws of heredity increases rapidly; Darwin expected such an increase, and made full allowance for it. He knew nothing of Mendel, but he exemplifies the law now known by Mendel's name. However much our knowledge of heredity may progress, Darwin's position will be but strengthened."

"Critics often accuse Darwin of ignorance, whereas it is their knowledge of this book which is at fault," Sir Arthur Keith concludes. "It is never safe for a biologist to announce a discovery if he has not read and mastered 'The Origin of Species.'"

The Close of the Age of Mammals.

By H. J. Massingham.

After giving some startling facts to show how rapidly man is exterminating other forms of mammalian life, Mr. Massingham concludes : " It is very certain that if the students of evolution do not take quick steps to guard its inheritance . . . posterity will exclaim ' But what have you left us ? ' "

It is a curious psychological problem as to why so little interest or concern has been aroused over the virtual ending of an historical and prehistorical period, corresponding in length with a geological one, and roughly known as the Age of Mammals. Our own age is one in which general information is rather over—than under—diffused, with the result that a vast mass of trivial matter is made common property ; the study of animal life has been developed to such a pitch that the danger is more one of over-specialization than of incomplete knowledge, while what is vaguely termed the humanitarian movement is no longer the forlorn effort of a small minority beating in vain against the *vis inertiae*. The boundaries of the world have been drawn into narrower and yet narrower compass by the progress of mechanical invention, and a Bestiary of fabulous animals printed only 300 years ago would excite the ridicule of the most illiterate to-day. Yet a modern world which is so widely educated, possesses such general stores of knowledge, and prides itself upon new susceptibilities, has been heedless or indifferent to a tragedy whose irrevocable magnitude leaves the imagination aghast. That tragedy is perhaps best summed up in the title to this article—" The Close of the Age of Mammals."

Universal Destruction.

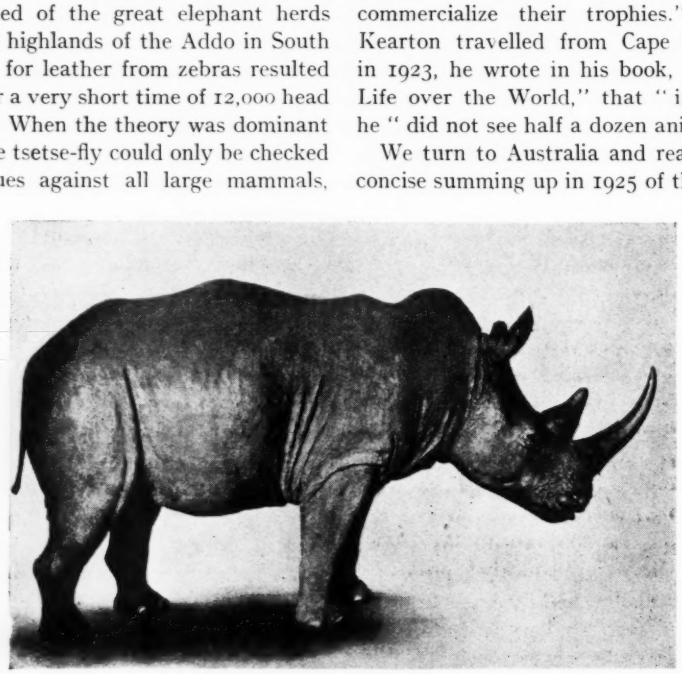
Of the destruction of wild mammalian life on a universal scale there can be unhappily no doubt, and I will quote some authoritarian figures and comments to illustrate it, so that I may avoid the impression that so stupendous a phenomenon as the last phase of a distinctive epoch which opened in the Eocene period is a misuse or extravagant use of the term. We have first of all to record the total disappearance of such animals and birds as the Blue Buck, the Quagga, Burchell's Zebra, the Passenger Pigeon, the Great Auk, Steller's Sea-Cow, some of the great Land Tortoises, and other species of bird, mammal and reptile within the last hundred years. If no radical change takes place in the rate, scope, and inducements of present-day intensive slaughter, these vanished ones can only be the precursors of a host, and, of course, those animals which are nearing or have crossed over into the desolate country of extreme rarity are twenty times the number of those who will never again be seen on the earth.

Let us take a brief survey over wide continental tracts so as to observe the general status of wild life more closely. India, for instance, was scientifically examined with a view to such an estimate by the Faunthorpe-Vernay Expedition less than five years ago. Lieut.-Col. Faunthorpe found that the Indian Antelope (*Antilope cervicapra*) " is now very rare," while not a single member of the Great Indian Bustard (*Chariotis edwardsi*) was seen by the expedition, nor, in spite of careful inquiries, was any live specimen reported. The Brow-Antlered Deer was declared extinct all over the " dry zone " of Burma, and the once common Swamp Deer was very scarce. The Indian Gazelle (*Gazella bennettii*) was reduced to a like poverty of numbers by the method of driving the terrified animals into ravines with nets stretched across them. In the once teeming country of Nepal Terai, it is now, said the head of the expedition, " extremely unusual to see any deer at all." The Pink-headed Duck (*Rhodonessa caryophyl-lacea*) is now extinct, while the Great Indian One-horned Rhinoceros (*Rhinoceros unicornis*) only survives in a small district of British Assam. Both the other Rhinoceri of South-eastern Asia (*Dicerorhinus sumatrensis* and *Rhinoceros sondaicus*) have become so rare as to be in urgent need of the most stringent protection. Sir Hesketh Bell only the other day (16th May) described a new method of taking Orang-Utans in Sumatra which is depopulating their remaining haunts. With these facts before him, it is not surprising that Lieut.-Col. Faunthorpe concluded that " within a measurable space of time there will be practically no game (outside the Government Forest Reserves) left in India."

The Decline in Africa.

The story of the decline in the wonderful and varied mammalian fauna of Africa has been so gloomily a dramatic one that knowledge of it is more widely distributed. It is unnecessary, therefore, to recapitulate its main features. The work of the hide-merchant, the ivory-hunter, the trader in captive animals, the irresponsible big-game hunter, the settler and the blinded tsetse-fly expert, has been done with

that degree of efficiency which has excluded wisdom and humanity. The data, collected by game-wardens and naturalists, and scrutinized by such a body as the Society for the Preservation of the Fauna of the Empire, is in no doubt, and yet reads like the sensation-mongering of the yellow journalist. Only thirty or forty animals remained of the great elephant herds that once roamed the highlands of the Addo in South Africa. The demand for leather from zebras resulted in the destruction over a very short time of 12,000 head in one small district. When the theory was dominant that the ravages of the tsetse-fly could only be checked by grand scale battues against all large mammals, incredible holocausts were made of them, reminding one of the huge massacres of bison in America, when the plains were being opened up. It was then discovered that the worst infected regions were those associated with the greatest paucity of game, while in Tanganyika the wholesale destruction of game has "diverted the fly to man."



THE WHITE RHINOCEROS.
The latest census of 1926-27 shows that only 150 specimens remained of this rhinoceros (*r. Simus*). It is the third largest land mammal still living, the height of the specimen here shown being 5 ft. 5 in. at the shoulder. (Photograph by courtesy of the British Museum (Natural History).)

By the 1926-27 census, only 150 of the White Rhinoceros (*Rhinoceros simus*), the third largest land mammal still living, were left, while the Annual Report of the Transvaal Game Reserve in 1925 described the Black Rhinoceros (*Rhinoceros bicornis*) "as a type fast disappearing from even the best game countries of Africa to-day." The same report drew attention to "the virtual extermination" of the warthog between 1914 and 1919. A similar reckoning, more than confirmed by the investigations of the late Sir Albert Grey, gave the number of gorillas, the ferocity of whom has been a particularly tall traveller's tale for a century, as only 100 within the limits of Uganda. It would take too much space to detail the reduction of giraffes and various antelope, such as the Mountain Reedbuck (*Cervicapra fulvorufula*) and the Oribi (particularly *Oribia scoparia*), from the richest abundance either to rarity or the verge of extinction The use of colubus and blue monkey skins by the fur trade has had a like disastrous effect upon their numbers. As elsewhere in the world, the major destruction of the African fauna has been not for agricultural protection but trade exploitation, and, as the Game Ranger, Captain Caldwell, remarked two years ago, "the quickest and most certain way of wiping animals off the face of the earth is to commercialize their trophies." When Mr. Cherry Kearton travelled from Cape Colony to the Congo in 1923, he wrote in his book, "Photographing Wild Life over the World," that "in hundreds of miles" he "did not see half a dozen animals."

We turn to Australia and read Sir James Barrett's concise summing up in 1925 of the status of Australian mammals: "Except in certain places where enlightened citizens have protected them, they are all disappearing. In no other continent has the devastation been more rapid than in Australia." Three millions of their skins were exported to the United States alone in 1924, and the Tasmanian Wolf (*Thylacinus cynocephalus*), of special interest to science as a primitive carnivorous marsupial, is in danger of extirpation. A characteristic victim of the thoroughness of American methods is the Prong-horned Antelope or Prongbuck (*Antilocapra americana*). In this case the destruction was for food. Between the Mississippi and the Pacific coast and from Canada to Mexico, it was calculated that the Prongbuck existed in actually greater numbers than the bison in the day of his glory. Though this antelope's agility is such that it can travel at the speed of almost a mile a minute, the 1927 census revealed his complete tally as only 49,000 head, half of which were in Wyoming alone.

Whether and however far we travel, north and south, east and west, from land to sea, from torrid to frigid zone, from jungle to desert, we are confronted with the same monotonous version in our own enlightened age of the story of the Gorgon's head which turned all it looked upon to stone. It was calculated in 1925 that not more than 250 Musk-Oxen

(*Ovibos moschatus*) had survived the demand for their hides throughout the whole American Arctic where they roam. Modern commence has had no sentimental consideration for an archaic beast who captured the imagination of our palaeolithic forbears. Polar and grizzly bears, once common animals and the material of so many half-legendary tales, will soon have become all legendary indeed, since they have been forced by swift depletion of numbers into the most inaccessible districts of their range. Even more lamentable is the diminution of the sea-mammals, many of whom are only clinging on to life by their claws. The numbers of the fur-seal herds in the Pribilof Islands were estimated at from two to five millions in 1867, and at 132,000 in 1910. Others of the family have not been so fortunate in the drastic protection that has now been accorded them. The Sea-Elephant (*Macrorhinus leoninus*) that once thronged and enlivened the Californian coast has been so persecuted by commercial enterprise that the *Morning Post* in November, 1922, remarked: "How long their diminished hosts will survive depends on the measure of protection accorded them by international legislation." As is well known, the mighty Sperm Whales (*Physeteridae*) are hardly better off.

THE NORTHERN SEA-ELEPHANT.
The sea-elephant that once thronged the Californian coast of America in large numbers has been greatly persecuted. The diminution of sea mammals is even more marked than that of their land relatives. (Photograph by courtesy of the British Museum (Natural History).)

The facts of the pauperizing of the earth by the destruction of wild life are indeed so overwhelming that they may well stand without comment, since no comment can equal much less enhance the significance of the figures. The "spread of civilization" is often quoted as the inevitable cause for this impoverishment, whereas a consultation of the data unmistakably reveals that commerce is the real Angel of Death. I quote here some figures gathered from lots offered in fur sales alone by one firm alone in one month alone (January, 1927): Fox, 40,000; Gazelle, 10,000; Flying Squirrel, 21,000; Wild Cats, 35,000; Marmot, 65,000. Here is another list from another lot offered in the same month: Fox, 30,000; Beaver, 9,500; Bear, 3,200; Ermine, 6,700; Mink, 10,000; Musquash, 46,000; Martin, 13,500. A third lot in the same month: Gazelle, 10,000; Squirrel, 23,000; Monkey, 2,000; Red Fox, 7,500. A fourth list also in the same month: Ringtails, 100,000; Wallaby, 330,000; Australian Opossum, 360,000. I will give selections from two more sales, one on 7th May, 1927, and another on 3rd September, 1927: Skunk, 150,000; Squirrel, 500,000; Fitch, 65,000; White Hare, 10,000; Marmot, 55,000; American Opossum 400,000; Squirrel Tails, 1,500 lb. The autumn list includes 400,000 Squirrel, 50,000 Fox, 36,000 Ermine, 30,000 Sable, 80,000 White Hare, and 100,000 Peshaniki. The variety of animals listed is astonishing.

There could be no reader, however little his sympathies or interests turn towards the animal kingdom, who, in running his eye down these lists, would not feel some shame at the thought of the spectacle modern civilization would present before some extra-mundane tribunal. Whether his imagination be exercised by the enormity of the bare figures themselves, or by the sufferings of the animals, he cannot but wonder if our stewardship of the earth by right of evolution has been employed to the best ends of that great process. This, above all, is the question that will most concern the kingdom of science. The ferment of mind which was set in motion by the discoveries of Darwin cannot but view with dismay the threat to the further continuance of that process, which an insensitive commerce has brought upon the world. The bare contingency of the close of the Age of Mammals is a matter of such urgency to men of science that it should surely be they rather than the layman, ignorant of the extent or meaning of the disaster involved, who should press for international action at Geneva to conserve the dwindling life of our planet. It is very certain that if the students of evolution do not take quick steps to guard its inheritance and bestir governments from their lethargy, posterity will exclaim, "But what have you left us?"

Some Problems of Coral Growth.

By Cyril Crossland, M.A., D.Sc., F.Z.S.

Much has still to be discovered about corals. Whether their age is passing, is one of the problems which the author will investigate during a further visit this summer to the coral islands of the Southern Pacific.

THE two main constituents of coral reefs are the "madreporic" corals and the stony seaweeds, the Lithothamnionae. The former are very distinctly animals, the latter quite completely plants; they are neither of them in any way intermediate between the animal and vegetable kingdoms. The corals, though so lowly, are not members of the lowest of the animal groups, while the stony seaweeds belong to the most specialized division of the algae, the Rhodophyceae or red seaweeds.

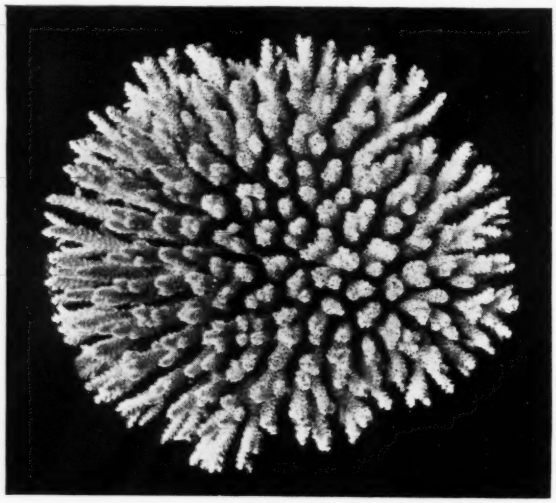


FIG. 1a.
THE NORMAL FORM OF *ACROPORA HYACINTHUS*.
This abundant coral is here seen from above as a large flat disc, bearing upright branchlets. The colonies, often a yard across, are so delicate that great care is needed to take a specimen ashore unbroken. (See also Fig. 1b.)

The coral polyp may be easily understood by the examination of the sea-anemones so abundant on every coast, and now so well displayed in the aquarium, among others, of the Zoological Gardens in London. The coral polyp differs from the "anemone" only in that the former secretes a little cup-shaped seat for itself, into which it can shrink for shelter, and by which it is raised a little above the rasping of the sand swept to and fro on the sea bottom. The simplest instance is afforded by the little *Caryophyllia* of the south-west coasts of England, in which each anemone has its own cup; from this the large branching or massive corals of the tropics are derivable merely by the multiplication of such limestone cups and by their remaining attached to one another, which is brought about by the power possessed by most corals of vegetative, or *a-sexual*, reproduction. The ordinary sea-anemone will stand almost any amount of mutilation, each fragment afterwards growing again into a complete animal, and with the corals this has become a regular method of reproduction; a polyp which exceeds the normal size may divide itself into two by a partition, or the base of a polyp that happens to extend over the stone to which it is attached may bear swellings which develop into daughter polyps. In this way a single polyp may multiply into hundreds, all remaining attached to one another and connected by their secreted supports into one mass. This may either be branched like a tree or it may be a solid dome-shaped or cylindrical mass—a stone a few inches in diameter or a rock up to twelve feet, the product of many thousands of polyps which have lived for hundreds of years.

In this method of reproduction there has been neither egg nor fertilization by the male element, the spermatozoon, but these are nevertheless formed, and by their union give rise to a *sexually* produced larva, which swims and drifts freely in the sea. Should one of these larvae meet with a suitable place for fixation it becomes a tiny anemone, at once secretes its stony seat, multiplies rapidly by a-sexual division or budding, and so founds a new colony. Thus the coral has two methods of reproduction.

The plant-like a-sexual reproduction has some remarkable consequences in the forms of growth, and in the survival of corals upon reefs and their recovery from the destruction wrought by violent hurricanes. The latter was experimentally demonstrated in the course of my cultivation of mother-of-pearl shell in the Red Sea, in which a novel form of oyster bed was made by crushing down the coral along the edges of lagoon reefs with heavy road stampers. A mile or two of gravelly surface was thus produced, covered with water from a few inches to three feet deep according to the season, the general level of the Red Sea being higher in winter than in summer. On some parts of these queer beds pearl oyster could be cultivated very successfully, on others the results

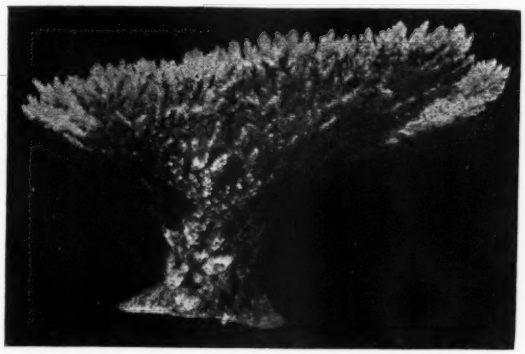


FIG. 1B.
SIDE VIEW OF *ACROPORA HYACINTHUS*.
Similar coral as in Fig. 1A, showing that the colony is supported above the sea bottom by a stalk. Modified forms are illustrated in the other photographs.

were poor. Much of the coral died when thus stamped down and became covered with fungus, the stench of its decay filling the air, but numerous small branches remained alive and continued to grow, sending up vertical branches just as in the case of plant cuttings, so that in two years time the beds were again covered with coral. In all the specimens I examined this new growth of coral arose from the old branches, and none from colonies freshly founded by sexually produced larvae. We had here two rather astonishing results—the vitality of the broken branches, and the absence, or at any rate rarity, of new colonies.

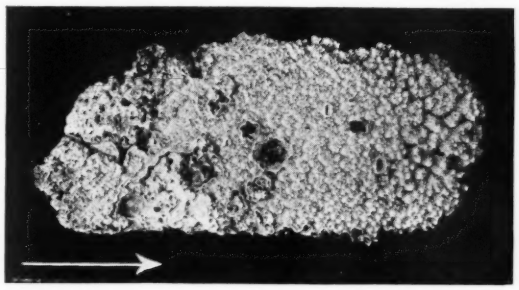


FIG. 2.
SAME SPECIES MODIFIED BY WAVE ACTION.
The same (or closely allied) species has here become a mere slab of solid stone, but it still bears the little branches characteristic of these "bouquet" corals. The arrow indicates the direction of the waves flowing over the reef edge.

This last discovery was not, to me, quite unexpected. In the laboratory it has been found easy to obtain young colonies from the sexually produced larvae of corals, which readily attach themselves to tiles. In order to test this under natural conditions I repeatedly placed tiles among the corals of a rich and undisturbed reef, expecting to obtain a large variety of young corals similar to those species among which the tiles lay. However, after years of exposure, the result was the collection of a few specimens only of one species of *Pocillopora*; none of the larvae of the many other species with which they were surrounded had been able to attach themselves. An exactly similar result was found with some pearl oysters which were laid near-by for years, although the shells were expected to afford ideal settling areas for the coral larvae. It is true that pearl shells with attached corals are common enough, both in the Red Sea and in the Tuamotu Atolls of the Pacific—a curio shop in Tahiti, for instance, contains examples bearing fine colonies of *Acropora*, *Porites*, *Pocillopora*, and others; but considering the immense numbers of shells fished the rarity of such growths is most marked. Shells from the Red Sea beds did not bear corals in more than one case in several thousand. All this seems to indicate that the great crisis in the life-history of a coral is the attachment of the larva and the growth of the first polyps; the foundation of a new colony is a rare and difficult event, but once established and well supported above the bottom, the battle is won, the vitality of the colony making it safe for many years whatever mechanical injury it may suffer. Much the same applies to the large mother-of-pearl "oyster." Hence the foundation of a new coral reef, or the recovery of one which has been killed by the mud and fresh water of an exceptional flood, may be very slow, whereas recovery from the mechanical damage of a hurricane may be immediate. Such a flood catastrophe overtook the lagoon reefs of the south coast of Tahiti during my previous visit,* and it is my hope this summer to record the stages of recovery as formerly I recorded those of death. Contrary to

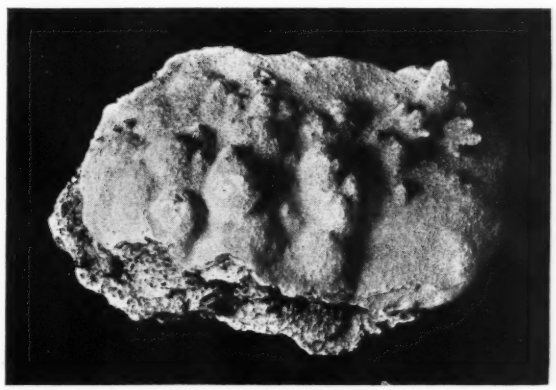


FIG. 3.
ANOTHER STALKED *ACROPORA*.
In this specimen, even the vertical branchlets are practically suppressed, showing extreme adaptation to environment. It now looks like a rounded *Porites*.

* Described in *Discovery*, July, 1927. "Exploring the Coral Reefs of Tahiti." C. S. Crossland.

expectation, all the species of corals did not die at the same time, while some species which seemed unaffected at the time succumbed a week or two later.

Changes of form of one and the same species of coral under different physical conditions in the Cocos Keeling Atoll have been described by Professor Wood Jones, whose account I am able to amplify somewhat from my observations in Tahiti. As already described in *Discovery*, the most abundant corals of the outer reefs are the stalked species of *Acropora* (*Madrepora*). Exposed to the surf, which often breaks with tremendous force, these delicate forms would be smashed to pieces immediately, but they have adapted themselves vegetatively to a form in which they can withstand the terrific pounding of the waves and the wild floods of water poured over them into the lagoon. The stalk disappears, the interlacing branches coalesce into a solid mass, and the upright branchlets become still shorter or disappear altogether; the coral bouquet found in deep or sheltered water thus becomes a mere slab of stone, with no resemblance to the normal form, except in occasional detail. The comparison is shown in the three accompanying photographs. Fig. 1 is the delicate bouquet, which must be handled with great care if it is to be taken ashore unbroken; Fig. 2, a slab with the vertical branchlets just visible; while Fig. 3—a different but similar species—is a rounded mass such as might be formed by a *Porites* instead of being an *Acropora*, a genus so typically branched.

Extreme Changes.

The impact of the waves alone does not cause these astonishing modifications, for only a couple of feet below tide level, where wave motion must be just as violent, apparently normal stalked forms live. When broken across, however, as in the example in Fig. 4, such forms are seen to be highly modified, being thick and solid right to the edge of the disc, and of a denser material than that in Fig. 1. It is clear that the violent and shallow current over the reef edge is the main cause of the alteration of *shape*, and its direction corresponds with the shape of the coral. These are extreme changes in response to violent differences in the conditions under which the animals live, but less marked differences are impressed by minor changes in environment.

It is well known how impossible it is to classify plants by their growth form: leaves, or any set of organs but the flower, are structures so completely subject to environmental changes that they do not indicate the relationship of species. But for the flower, what structure could indicate the close relationship between the red sorrel (*Rumex*) of our hay fields, and a bush in East Africa or a gorgeous pink-flowered creeper common in tropical gardens? The classification of corals is in somewhat the hopeless position in which classification of plants would be without the aid of the flowers. The genera are clear; there is enough constancy in the structure of the coral thecae, etc., to show that certain branched forms are of the same genus as others which grow in solid lumps, or that the loosely branched species of Fig. 5 is but another *Acropora*—the genus to which all the other corals here illustrated belong. But the discrimination of species is so complicated by these vegetative variations as to be nearly impossible. The only hope is that further knowledge of the soft parts, which are not so likely to be affected by external conditions, may provide diagnostic characters that can be more safely applied. Only the beginning of this method has yet been made.

Tahitian Fauna.

The Tahitian coral fauna present other interesting problems. Farthest out in the Pacific Ocean, and the least known of all its many archipelagoes, are the Marquesas Islands. Between these and the Society Islands lies the great archipelago of the Tuamotus, which is made of coral alone, yet the high islands of the Marquesas have no reefs whatever! Many theories, chiefly geological, have been put forward to explain this anomaly, but the problem is mainly one for the biologist, as it was found* that the coral fauna is extraordinarily restricted, careful collecting giving only five genera of corals with about twelve species. By comparison the fauna of Tahiti at first sight seems to be as rich as that of other coral seas, but soon the absence of many old friends becomes striking. Where are all the Astreans, the solid dome-shaped corals of which we expect to see many masses several feet in diameter on every reef, and their allies the "brain corals"? And why is there no *Galaxea*, which consist of great masses of stone quite hidden under thousands of the long green tentacles of its polyps? As *Pocillopora* is abundant, it is strange to see nothing of its nearest allies *Stylophora* and *Seriatopora*; while *Mussa*, which makes masses six to twelve feet in diameter everywhere in the Red Sea, with its great calyces and big velvety brown polyps, is another form that is almost entirely absent from Tahiti.

This restriction of the coral fauna is usually explained as due to the isolation of the islands so far out into the ocean, which, with the fact that the general oceanic circulation is from east to west, makes

* On the voyage of the "St. George." *Discovery*, Vol. VI, p. 423.

it difficult for the floating larvae to reach them. Indeed, it is difficult to see how the larvae arrived which have colonized these shores; certainly none have crossed from South America, the only coasts which lie to windward. The case of *Mussa* seems to indicate that isolation is not the whole story, and that adverse local conditions, of some kind as yet unknown, have had at least as much to do with the matter as any difficulty of the larvae in travelling so far out into the ocean. *Mussa* has arrived, but is unable to grow to its normal size or to establish any number of colonies. The case of other Astreans seems to be the same, since collecting revealed the presence of only ten species; all were insignificant little things, except one specimen which attained the very small maximum size of six inches in diameter. *Stylophora* has arrived; it was found only once in a tiny colony, but it grows to proper size on the Tuamotuan reefs, still further out in the ocean.

It was therefore surprising, in visiting Rarotonga, 630 miles to the south-west of Tahiti, to find the shore strewn with "brain corals" and the other forms so conspicuously absent from Tahiti. As Rarotonga is an older island, conditions are probably better for coral growth, owing to the greatly reduced outflow of alluvium into the sea during floods; Moorea Island is in much the same state, yet it has no coral species not seen in Tahiti. The whole problem of the distribution of corals in the eastern Pacific promises to be most interesting, and its solution will doubtless throw light on general problems, as well as on the foundation, growth, and decay of coral reefs.

In conclusion, is the age of corals passing? Has the fauna around Tahiti always been so poor—were the missing Astreans, for instance, formerly there at the time the reefs were growing up? Geological evidence there is none, and without borings it is unattainable, as the only elevated rock is of far too recent origin to answer this question. Even the lower stratum has no species not now living on the Tahitian reefs, though it contains a coral not usually seen in the lagoon.

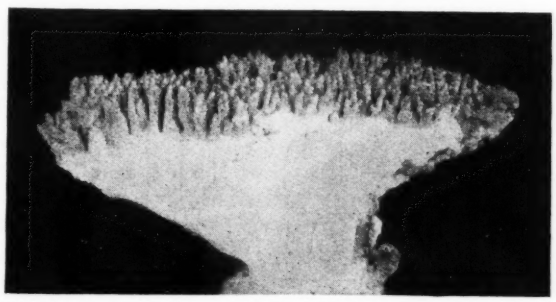


FIG. 4.
SOLID FORM OF NORMALLY DELICATE "BOUQUET."
This grows in about two feet of water on the seaward edge of the reef, and seen from above it resembles the normally delicate form. (It is here broken vertically across the centre.) The great thickening and solidity of the fused branches enables the coral to resist the pounding of the surf.

FIG. 5.
"STAG'S HORN" CORAL.
One of the loosely branched "Stag's Horn" corals, which, in spite of the great difference in mode of growth, is merely another species of the large genus *Acropora*.

The cause of this reduction in the vigour of coral growths is not easy to find. It may be biological, concerned with the balance of life, either among the species of corals themselves or between those organisms that build limestone and those that destroy it. Or the cause may be physical, due to some change in the character of the water and its contents. There has certainly been a change in the latter in Tahiti, due to the decay of basalt into laterite, which is so conspicuous as a bright red clay on the hill slopes, and which pours in red streams into the lagoons after rain. This hardly seems to be all, however, for only the very exceptional storm and floods in January, 1926, had any effect upon the lagoon corals, and none upon those outside. Is this phenomenon of the death of coral reefs of local importance only, or is it possibly widespread? Is this, the latest of the ages of corals, passing or past? In 1902 I described how the broad reef of Zanzibar is really nothing but a wave-cut shelf, in the great mass of recently elevated coral that forms the coast of all tropical East Africa. In the Red Sea the reef is formed partly by the planing down of elevated coral and partly by growth, and when the limits of each can be made out, it is found that growth has added but a small proportion, even though coral grows there in astonishing abundance. In reading descriptions of other reefs also, the most striking impression gained is the scarcity of living corals in comparison with the immense structures produced by them in the past.

Modern Advances in Photography.

By T. Thorne Baker, F.Inst.P., F.R.P.S.

The important photographic congress which meets in London this month provides a suitable occasion for reviewing modern advances. In addition to cinematography Mr. Thorne Baker deals with colour work, including a new process designed for amateur use.

THE Seventh International Congress of Photography, which is being held at the Imperial College of Science from 8th to 14th July, marks another step in the history of photography. Three years ago the sixth congress was held in Paris, and the occasion was memorable chiefly for two reasons: international agreement was arrived at concerning standardized methods of testing photographic plates for their speed and other qualities, and Dr. S. E. Sheppard announced his discovery of the secret of sensitiveness of silver bromide to light.

It is interesting to look back this year, and to review from a chemical standpoint the great advances that have taken place recently in photography.

The Speed of Plates.

An immense amount of investigation has been carried out since Dr. Sheppard's announcement, as a result of which it is reasonably certain to-day that the fast plates of our time owe their extraordinary light sensitiveness to specks or nuclei of what might be termed foreign substances adsorbed by the grains. When an emulsion is made for a photographic plate it is only slightly sensitive to light until the final ripening process is given—this being a mere digestion or heating of the emulsion. During this brief final process the sensitiveness to light increases many thousands of times, provided always that the original grains have been prepared in suitable fashion. Now this tremendous increase in "rapidity" is only obtained when the silver bromide is suspended in gelatin, and Dr. Sheppard discovered that the minute traces of the sulphur compounds, such as allyl thiocarbamide, thiosinamine, etc., which may be present as impurities in gelatin, become deposited or adsorbed on the surface of the grains during digestion and act as sensitive nuclei. A great deal of work was involved in isolating these compounds from the gelatin, in which they are present perhaps only one part in three millions, and in showing definitely after their identification that their effect on the silver bromide was of such an important nature. Needless to say, a very large number of sulphur compounds have been tried, as well as many other compounds known to be responsible for increasing the sensitivity of the salts.

One cannot say, however, that as a result of these investigations any new plates of miraculous speed have been produced. Nevertheless, plates *have* been produced during the last few months by English firms which are in one case twice the speed of anything hitherto made, and in the other case of enormously increased colour sensitivity. New vistas are opened up by such plates for the astronomers, and this new material has already produced in their hands highly important results.

There are at least six directions in which marked photographic advances are being made to-day.

(1) Cinematography is undergoing a gradual but radical change. The introduction of commercial photo-electric cells has paved the way for the talking film, and whether this new achievement be actually regarded as an advance or as a nuisance, the talking film has certainly come to stay. The sound is recorded on the cinematograph film by photographing a band of light, the width or intensity of which is controlled by the movements of a galvanometer coupled up with the microphone. When the film is projected, the variations in light intensity of a special beam passed through the developed band on the film are used to set up correspondingly varying currents in a photo-electric cell, which after amplification actuate the loud speaker. The talking film is being perfected with surprising success, and it will without doubt play a prominent part in the picture theatres of the future.

Colour Cinematography.

Combined with the reproduction of music and the voice will be the natural colours of the original subject. During the last two or three years, different processes of colour cinematography have been brought, if not to perfection, to a stage where they can add considerably to the charm of the picture. Other processes of colour reproduction, although they have not so far been put before the public, have nevertheless arrived at a state bordering on maturity, and may be expected to be in evidence in the near future.

Cinematography has also made its appeal to amateur photographers, many thousands of whom

to-day take their own motion pictures, and can experience the pleasure of preserving their pictorial records in animated form. This new amateur art is developing with surprising rapidity, and has definitely taken its place amongst the hobbies of ordinary people. The amateur has only to turn the handle of the camera, or to press the button of the spring motor, and to direct his lens upon the subject. The ciné-film, daylight loaded and unloaded, is sent to the makers, and is developed and reversed into a positive for him within a few hours.

(2) Another advance for which perhaps this year will be remembered is the practical progress that has been made in the manufacture of "non-flam" film. Cellulose acetate can be cast as a transparent base for photographic films in place of cellulose nitrate (celluloid), and it possesses the important feature that it will burn either with difficulty or not at all. The importance of a non-inflammable film is easily recognized when it is remembered that the cinematograph is not only becoming used as a home instrument, but as a powerful aid to education, and that it is being quite extensively employed for business demonstrations.

X-ray Developments.

(3) Progress in the field of metallurgy, as well as in many problems relating to atomic structure, has been pronounced. Photography of the X-ray spectrum is receiving an immense amount of attention from investigators, and crystal analysis is becoming widely employed in metallurgical laboratories. The expansion of medical X-ray work is, from the public point of view, the most spectacular. The majority of hospitals of any size are equipped with powerful apparatus with which almost any type of diagnosis can be assisted. Some idea of the great power of modern installations—with which exposures through the body can be taken in a fiftieth or a hundredth of a second—may be gathered from the fact that high tension transformers, which excite the X-ray tube, have been made recently of as high power as forty kilowatts. A few years ago the use of bismuth and barium "meals" proved of great value in enabling photographs of the stomach and alimentary track to be procured. Recent technique has enabled us with the aid of solutions of salts of high molecular weight to photograph many other organs of the body hitherto impossible to diagnose by the rays. Immense sums have been spent on some of the equipments at the newer hospitals, and the first chair of radiology has been established at Edinburgh. It may be interesting to mention that at one London hospital post-mortem photographs are being taken of the complete body.

The importance of X-ray photography and radiology in general, may be gathered from the fact that this year an international congress, devoted entirely to the subject, is being held at Stockholm. Accommodation has been found for the meetings in the parliament buildings, and the lively interest evinced by this country of prodigious scientific attainment is well shown by the kindness of the King and Queen of Sweden, who are receiving the members of the congress at the palace.

Panchromatic Films.

(4) Of interest to the amateur photographer is the new material offered in the way of panchromatic film. Film sensitive to all visible colours is now almost universally used for aerial survey—a very thriving branch of modern photography—for most cinematography work, and for a great deal of scientific recording. Its merits in the way of truthful tone rendering have been long appreciated by photographers, but it is only this year that panchromatic roll films for the ordinary amateur have become available. Another form of photographic material which bids fair to become an important rival to the dry plate is the film pack. Six or a dozen films are placed in a flat pack which takes the place of the dark slide, and by merely drawing a paper tab the film just exposed is brought to the back, leaving the one immediately behind it in position for the next exposure. Film packs are becoming widely adopted all over the world, and the introduction after many years of experiment of the Imperial panchromatic pack a few months ago has made it possible to deal with many types of scientific work without the use of glass plates.

A further novelty in the way of colour is a triple roll film with which, in an ordinary snapshot camera, blue, green and red records can be obtained with one exposure for subsequent printing in natural colours. This roll film for colour photography is the outcome of a good deal of intensive work, which has been done during the last few months, in perfecting the somewhat old idea of exposing a blue-sensitive, green-sensitive, and red-sensitive film one behind the other, thus obtaining the three-colour sensation negatives simultaneously. The "red" negative is, of course, exposed *through* the green and the blue negative, and the green negative through the blue. An elegant method of printing has been invented, in which three transparent films are used; these print out as a visible image—one in yellow, one in crimson, and one in blue. The three transparent pictures only require a rinse

after printing, and while wet are brought into contact and squeegeed in register on to a paper support. The colours are surprisingly truthful, and an exhibition of these pictures which was given at the recent Congress of Professional Photography caused lively discussion.

(5) If telegraphy can be called a branch of photographic work, then this science, too, may be said to have added lustre to the photographic brilliance of the year. The telegraphic transmission of photographs has been taken up by many leading newspapers in England, although it must be noted with regret that they are only following in the footsteps of foreign newspapers who had patronized the electrical method of picture transmission a long time previously. Pictures have recently been telegraphed in natural colours, but the quality of black and white reproduction has now reached such a state of perfection that only experts can distinguish the wired results from the original pictures.

A New Printing Process.

(6) The present-day reproduction of photographs by photo-mechanical methods is so good that it is difficult for the layman to keep fully alive to the constant improvements taking place. Nevertheless, in the field of rotary photogravure, offset lithography, and the cheap printing of music and book reprints, progress has been made greatly to the benefit of the general public. One of the most striking of new processes is Pantone, which has made it possible to print the finest reproductions on low grades of paper, thereby opening up new prospects for the better illustration of cheap literature. The half-tone screen negative is printed upon a chromium plated copper or steel plate, sensitized with fish-glue in the usual manner. After the unexposed parts (in between the dots) are etched away, the metal is plated with silver, and without further etching the block is printed with an ink containing a trace of mercury. The mercury instantly amalgamates with the silver and repels the ink, keeping it entirely to the surface of the half-tone dots, however small. The result is that reproductions made with the finest screens can be clearly printed on the coarsest and commonest papers, at a great speed.

In conclusion, some mention must be made of the splendid work done by the members of the British Photographic Research Association under the able leadership of Dr. T. Slater Price, F.R.S. An immense amount of fundamental knowledge concerning photographic chemistry has been established by Dr. Slater Price's able staff, and their researches have done much to help forward the photographic industry, not only in this country, but throughout the world.

Correspondence.

EXCAVATING IN PALESTINE.

To the Editor of DISCOVERY.

SIR,

I was very much interested in the article in your June number entitled "How the Modern Archaeologist Works," particularly in view of the fact that I spent the greater part of one year in the district described. This was immediately before and after the third battle of Gaza, and I can appreciate the very great difficulties the excavators must have in discovering likely sites on which to work, for the speed with which the sand storms obliterate all evidence of former occupation is remarkable.

I well remember, in visiting the villages of Deir-El-Bela, Khan Yunis, Beni-Selis, and Um-Gerar, the suspicious way in which the natives looked upon every form of employment offered to them, and my recollection is that although many of the inhabitants were agreeable enough, some showed by their attitude and actions that petty robbery and preying on caravans was more to their liking than labour.

The best labour we had in Palestine at this time was provided by the Egyptian Labour Corps, the members of which received five piastres a day, serving for three months, and then returning to Egypt for ninety days' interval before joining up again. The remarks made by Lieut.-Commander Trumper as to the sharp eye which had to be kept by the excavators on the working gangs claiming their pay, recalls the fact that the principal use the E.L.C. labourers had for their five piastres was for gambling, and that while many of them went for their ninety days' leave with plenty of money, the rest had nothing to spend when they arrived in Cairo.

I had under my charge for a time some fifteen to twenty wells in the neighbourhood of Gaza, and my recollection of the water obtained from them is that, on the whole, it was sweet and good, a sweetness which we interfered with seriously by the introduction of chlorine as a safeguard against contamination. Those of your readers who may remember chlorinated water in Palestine during General Allenby's operations will agree that while it was detestable for making tea, with whisky it was almost undrinkable. I believe I am right in saying that General Allenby refused to drink chlorinated water at Headquarters Mess.

It was easy to obtain water near the coast by making a shallow depression in the sand, but this water was nearly always brackish and only natives would drink it. Many thousands of camels used to come in to the wells of the villages near the coast after days without water on the desert. Notwithstanding thirst, they would patiently wait their turn in long queues, and if the water (pumped up by the engineers into shallow troughs) was too cold, the camels would wait until instinct told them it had arrived at a temperature which made it safe for them to drink.

It was always a mystery to me how the Bedouin managed to keep their animals alive at all, and the success with which the camels and asses were hidden among the sand dunes of the desert was equally surprising.

Yours faithfully,

EDWARD W. GREGORY,
Capt. (R.A.M.C., T.F., Rtd.).

8 Chepstow Place,
London, W.2.

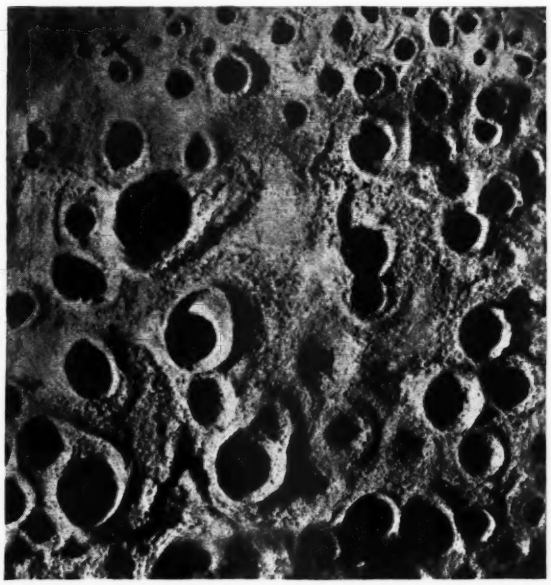
"UNSOLVED PROBLEMS OF THE MOON."

From Professor J. N. Collie, F.R.S.

To the Editor of DISCOVERY.

SIR,

I was much interested in a photograph of the moon you published in this month's *Discovery* (June, page 190); because a few years ago I obtained a series of "craters" in a semi-solid mud, that were very similar in appearance to those on the moon. The one marked X on the accompanying photograph



is almost exactly the same as the one in the left hand top corner of the moon photograph on page 190. The rest also bear a very similar resemblance. The way in which the "craters" were obtained was during the evaporation of alcohol from a compound in a large flask; when nearly all the alcohol had boiled off a semi-solid residue was left. On reducing the pressure by means of a pump, the remaining alcohol in the residue rapidly vapourized in the flask, and produced the "craters" in the semi-solid residue. The result was thought worth while photographing.

J. N. COLLIE.

Chemical Laboratories,
University College, London.

MECHANIZATION IN AMERICAN INDUSTRY.

To the Editor of DISCOVERY.

SIR,

Shortly after seeing your article on "Economics and Education in America," published in June, I read with interest a statement by an American authority which largely confirms your views. This dealt with the charge of over-mechanization in industry, and was written by K. H. Condit, secretary of the Princeton Engineering Association.

After remarking that from the purely humanitarian point of view it would be a big step backward to discard the mechanical devices which have largely replaced unnecessary toil, he questions whether many of those who talk of over-mechanization ever did any of the back-breaking jobs which machinery has replaced. With regard to the criticism that machines have killed creative intelligence and made life a horrible monotony, especially in motor-car manufacture, his experiences in a modern assembling plant suggest that this effect is not widespread. Here the cars were coming off the end of a line of machinery at the rate of about one a minute. "It seemed to me," Mr. Condit writes, in the *Princeton Alumni Weekly*, "that there was a whole lot of the game spirit in it. I was particularly amused by the young fellows who drove the assembled cars across the twenty feet of space from the end of the assembly line to the beginning of the final inspection line. The motors were running as these boys slid into their seats, threw in a gear and speeded up across the first seventeen feet, to come to a sliding, wheel-locked stop during the remaining three. I held my breath as the first three did this stunt, but I gathered at last that it was a matter of pride to stop with the glasses in the headlights not more than an inch from the rear of the car ahead. Anyone who left a longer interval was in disgrace.

"I suppose these boys were indulging in a species of 'showing off,' but at any rate they were having a pretty good time. Further back along the line, where there was not the same opportunity to take chances, there seemed to be a general spirit of team play, fostered perhaps by a group bonus system that rewards every member of the team if the group as a whole reaches or exceeds a given standard. I don't know what payment system is in vogue in this plant, but I failed to see any evidence on these men of the deadening effect of their specialized work. They seemed to be perfectly normal as they started for home at five o'clock, with several hours of daylight for gardens or baseball or any other activity that appealed. I could not help but think of the eleven-hour day worked by their grandfathers, before engineers had made their presence felt.

I know that purely political discussion is foreign to the policy of your journal; but as an American who regards the British discovery of his country as essential to friendship and world peace, I think more knowledge of our economic situation can only be of serious scientific value.

Yours faithfully,

Lake Forest, Illinois. DURAND SMITH.

FINGER PRINTS ON PICTURES.

To the Editor of DISCOVERY.

SIR,

In view of Mr. C. E. Hughes's article relating to the identification of pictures, it may interest your readers to know that a new method of uncovering counterfeit paintings of old masters has been advocated by Dr. Hiendl, a German finger-print expert. The *Finger Print Magazine* (Chicago) states that as a result of his investigation in the Munich picture gallery, it was found that the old masters, such as Rembrandt, Titian, Duerer, etc., had left distinct impressions of their finger-prints on the paintings. Those prints which were known to have come from the hand of the master were used as models by which doubtful pictures could be tested.

This method of identification is believed to be faultless for the paintings which have stood in the museums for more than thirty years or before the introduction of the study of finger-prints to Europe. The "rediscoveries" of the last three decades, however, will prove a tougher proposition, for the subject has been carefully studied by counterfeiters.

Yours truly,

Bangor, Carnarvonshire. THOMAS H. PARRY.

The "Death Trap" of Rancho La Brea.

By Robert Zander, Ph.D.

Certain oil wells in California have yielded skeletons of earlier geological periods. The tragic fate of being trapped in the oil is sometimes repeated to-day, and enables us to reconstruct the habits of the ancient animals.

WHILE searching for fossilized plants in the deep coal strata of the lignite mines at Geiseltal recently, I came across some leaves, for all the world as if they had just fallen from beech and willow trees. The importance of the position, and the fact that the geological conditions of the situation were known to me, was assurance enough that one could here go back many thousands of years in the world's history. It then occurred to me whether the processes which have stretched over great periods of the earth's existence could not be demonstrated by experiment? However, one finds that Nature herself experiments enough in these directions. The process of mummifying part of its products goes on daily in the earth, as a certificate of its development, not merely at a slug-like speed, but sometimes with the rapidity of a laboratory experiment.

Viscuous masses of oil well up from the ground which on contact with the air rapidly turn into asphalt; and woe to the animal that is caught through carelessness. It will be held fast despite all its struggles, till it sinks in the relentless oil, there to be conserved for all time. These oil traps are not, of course, very commonly met with, but where they occur, as, for example, in California, not far from Los Angeles, one of the best known petroleum centres, they are frequently found in a series, one after the other. One recognizes them with difficulty because of their general earth grey appearance, but in the early stages they are greasy black and glistening, and reveal that shot-silk effect which we sometimes see on asphalted roads on a rainy day, as a result of fine distribution of oil. Little wonder that animals at play, or hastily fleeing, are caught by such traps in which they are painfully sucked under. And, in spite of his capacity to recognize warning, even man has been often enough exposed to similar dangers in the over-grown bogs which still exist in many places. Stepping unwarily on the grassy surfaces he has been trapped in the bog, to become engulfed and mummified.

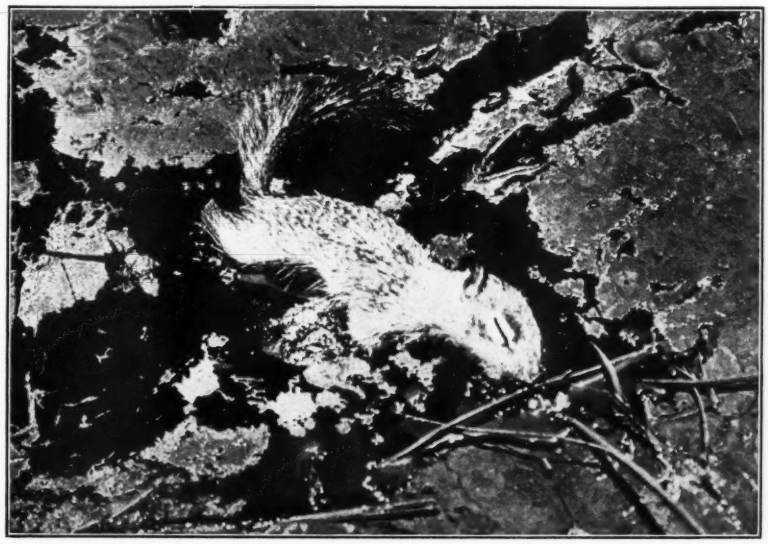
American observers in the area where oil patches continually appear afresh, such as that territory known as "Rancho la Brea," have often noticed how animals were caught in the oil, died and decomposed, and sank. The accompanying picture shows such an incident, which occurred in the vicinity of oil-well boring towers. Searching over an old oil source that had hardened into asphalt, observers came across a number of bones which proved to be of a long past period. Thereafter, source after source was inspected with astonishing results. One might say that the earth's diary could be read there. The results of the discoveries are to-day preserved in the Los Angeles Museum. There all is set out, and a thoughtful artist has painted a background suggesting a scene in the days when these bones were clothed with living flesh. But not only the Pleistocene period with its fighting

A CALIFORNIAN OIL POOL.

An oil pool, near Los Angeles, in which a dog was found entrapped. The animal had sunk near the bank at the spot indicated by a white arrow.

sable-toothed tigers, the giant mammals, vultures and mammoths, are revealed by the discoveries, but also clearly enough those times in which, as Heinrich Seidel says, "the mastodon strolled at his ease," and times when bison, puma, lion, cave bears, wolf, fox, and other animals mingled on the earth's surface.

Poetic as this may sound, it is a fact that modern observation and research enables us to obtain a clear picture of animals dead thousands of years ago. From the smallest particle the expert can reconstruct not only a fragmentary part of a past landscape, but he is able to unroll before us kinematographically living scenes. He finds bones revealing fractures which in the far off lifetime of the animal joined together again; malformation and crippling is also discovered, and by anatomical comparison with animals of the present day, he finds these ancestral beasts were of exceptional wildness. From the teeth is learnt whether the animal was carnivorous or vegetarian, if it were a beast of prey or a harmless creature. As conditions are to-day in the animal world, so it must have been in earlier times. When a creature, playing around, landed unconsciously in the asphalt, and in fear of its life cried out, the beast of prey was attracted by the screams in the hope of satisfying its everlasting hunger, unaware that this urge—the strongest impulse in its nature—was drawing it to the grave. This appears to explain why to-day we find such a number of skeleton parts within a small area, so to speak in pockets. And when the bones of primitive birds are found among them, we surmize that the birds were attracted by the insects swarming round the corpses of the animals, and, coming to feed, needed but to stir the surface of the asphalt to be caught and held by their wings in the sticky substance. They died, and to-day men study their cemetery with a curiosity that cannot be satisfied.



A VICTIM OF THE OIL TRAP.
Here a squirrel has been caught in the viscous oil, whose thin asphalt surface has broken under its weight.

Is there still so much to be discovered in the bowels of the earth? To-day we think we know how it was in the past, but to-morrow may bring forth something which will offer a quite different picture. We see to-day in the oil-pools the decomposed body of a dog, or a squirrel, caught in the tenacious liquid. Putrefaction-loving flies swarm over the decaying corpse; a bird comes to glut on the insects; that is the common scene, and we cannot think it was different in earlier times. As the gambolling dog, and the squirrel in his wild flight, fell into the oil-trap, was it not so ages ago? Not only the wild and high-spirited beast, or one in hasty flight, may meet with disaster; careful moving cattle can be deceived by the earth-coloured surface and be caught.

The oil areas are certainly not so rich in wild life to-day; industry and agriculture have driven it away, but in primitive times there was undoubtedly a very wealthy animal kingdom in their vicinity. That amongst these early animals many vegetarians have left their bones for us to study, shows again that the flora also must have been well developed. Around the vegetarians found in the oil-area, the carnivores complete the picture. The imperfectly healed breaks in their mighty jaws show that they had hard work to do at the kill, and the remains taken from the asphalt at Rancho la Brea confirm that the beasts of prey, which are sly and agile, sleep lightly and at the slightest sound are alert—ready to attack or fly in haste—lived exactly as their descendents do in our times. Such numerous injuries are evidence that the fight for life in the animal world is an ancient law of nature. So, after aeons of time, primitive life rises from the grave for our edification.

The New Cruise of the "Carnegie."

By J. P. Ault.

Commander, and Chief of the Scientific Staff.

After an interval of seven years, the American research ship "Carnegie" has again set out on a cruise planned to continue till 1931. The following information is issued by the Carnegie Institution.

CARRYING a party of eight scientists selected by the Carnegie Institution, the non-magnetic yacht *Carnegie* sailed on 1st May from Washington. The vessel has already made six voyages during 1909-1921, covering about 290,000 miles, in a magnetic and electric survey of the oceans. She was specially constructed and equipped for making these investigations, brass and copper being used in her construction instead of iron and steel, and is manned by a crew of seventeen men.

First (Captain Ault writes), we are going to find out what changes have taken place in the magnetic elements over the various ocean areas since the previous cruises of the *Carnegie*. This information is of interest to the student of the earth's magnetism in his study of the many unsolved problems in this science, and it will supply the values needed to keep the navigation charts up to date. These charts are used by the air pilot as well as by the sea pilot.

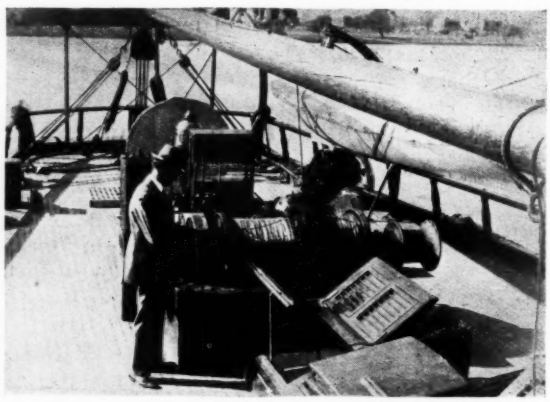
Among these unsolved problems are: the origin of the earth's magnetic field, the causes of the daily and seasonal changes in this field, the close relation between magnetic storms and the occurrence of polar lights and changes in the condition of the sun, and why we have eleven-year periods in magnetic changes and disturbances coincident with the well-known eleven-year periods in sunspot activity. To obtain the maximum of data regarding these changes, it has been planned to retrace to a large extent the tracks of former cruises. The causes of these changes and variations are not yet known, and their explanation constitutes one of the chief problems in the science of terrestrial magnetism.

The second important investigation will consist of a continuation of study of the earth's electric field. The importance of investigations such as this has increased in recent years because of the close relation between variations in atmospheric-electricity and variations in magnetic conditions. Also recent theories regarding the nature of electricity and constitution of matter and the rapid advances made in radio transmission have given added stimulus to these studies. The electric elements which we are to investigate again include the amount of electric charge in the air which increases with height above the earth's surface, being about 100 volts at the height of one metre. There are present in the air at all times both positively and negatively charged particles called ions, about 1,000 of each kind in a cubic centimetre of air, or 16,000 to the cubic inch, and with our instruments it is possible to count the number with fair accuracy.

Intimately connected with the number of ions in the air is its electric conductivity, or its ability to carry an electric current. Whether penetrating radiation, or "cosmic rays," coming into the earth's atmosphere from outer space can be one of the causes of ionization of the air which increases its conductivity is another of the problems to be investigated.

The amount of radio-active materials, such as radium and thorium, present in our atmosphere is collected and measured, this being another source of ionization. These investigations show that, under normal conditions, there is everywhere an electric current passing from the air into the earth. There is not enough of this current, however, to operate anything but a toy motor, and we need never fear electrocution from this cause.

Recent investigations of variations in radio transmission with changing magnetic and electric conditions have led us to install a very complete radio equipment



THE NON-MAGNETIC WINCH.

The author is here seen inspecting the electrically-operated winch equipped to reach a depth of four miles. The line, specially made of an aluminium-bronze alloy, is also non-magnetic.

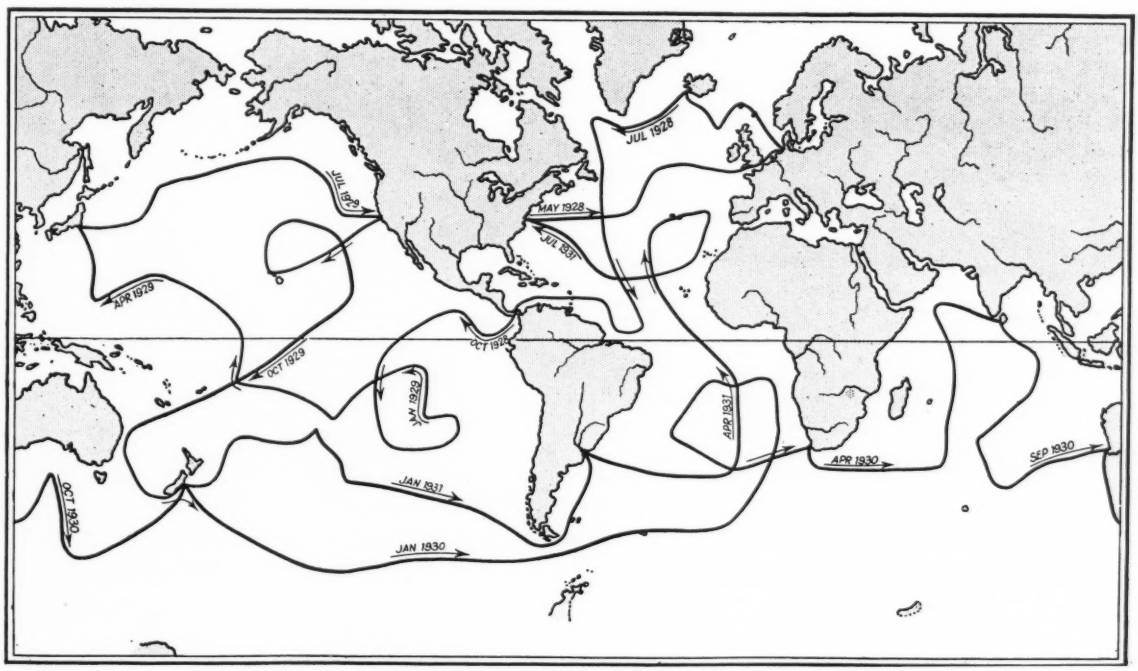
on the *Carnegie* for the first time. Short wave broadcasts will be received during the entire cruise, and a definite programme of transmission and reception is being arranged with the Naval Research Laboratory in Washington. Thus we will carry out experiments and investigations on the important problems of skip-distances and of variations in signal intensity. Time signals will be received daily, thus adding to the accuracy of our time-keeping and consequently to the reliability of our geographical positions at sea.

The mysteries of this vast, practically unknown, expanse of atmosphere above the earth's surface, and of the equally unexplored depths of the ocean, await the pioneering spirit of a Langley or the inventive ingenuity of a Lord Kelvin. When inventive genius makes it possible to investigate the modifications in magnetic and electric variations due to change in altitude, many new and important discoveries will be made.

The third general scientific problem to be investigated is oceanography, and we shall confine our attention to the physical and biological phases of this science. This will be a new field of research for the *Carnegie*. In spite of the considerable amount of information which has been accumulated by the various expeditions since the time of the *Challenger* voyage in 1872 to 1876, we have only a general idea

THE RESEARCH SHIP "CARNEGIE."

of the contours of the ocean bed, and only a meagre knowledge of the bottom sedimentary deposits which are of peculiar interest in the study of the age and formation of the earth and the changes which time has witnessed. The mapping of the configuration of these great basins covering over two-thirds of the earth's surface should be as important as the mapping of the land masses which occupy less than one-third. Such information will be useful in the study of movements within the earth's crust and of the origin,



TENTATIVE ROUTE FOR THE SEVENTH CRUISE OF THE "CARNEGIE," 1928-1931.

history, and probable future development of submarine earthquakes. So we have installed one of the recently perfected sonic depth-finders, loaned by the U.S. Navy Department, and we can determine in a few moments the depth of the ocean as the vessel is proceeding on her course. The method consists of measuring very accurately the time it required for a signal sent out from the ship to travel to the bottom of the ocean and the echo to return to the ship again. Sound travels at the rate of about 4,800 feet, a little less than one mile, per second, so that if the time between the signal and the echo is two seconds, the depth is about 4,800 feet.

Four Miles of Wire.

Some corrections to this assumed velocity are necessary on account of varying conditions of temperature and salinity, or salt content of the water, but we expect to measure these variations from time to time at various levels from the surface down to the bottom. We have limited ourselves to four miles of wire only, so the bottom of the sea will be out of reach in some of the greater depths. Approximately six miles is the greatest depth yet measured by wire, the location being near the Philippine Islands.

Water samples and temperatures will be secured by Nansen water-bottles and deep-sea reversing thermometers sent down to various levels, ten bottles being used on the wire at one time. The salinity and chemical content of each water sample will be determined immediately on board the vessel. Changes of temperature and salinity in vast bodies of water cause vertical movements which, combined with other relative movements due to wind and tide, make the ocean with its vast capacity for carrying heat a powerful factor in its influence upon practically every phase of life upon the earth, in its control of climate, and in its determining effect upon man's migration and habitation. Samples of muds and sediments from the bottom will be secured by use of various devices sent down on the end of the sounding wire. One sampler resembles the jaws of a turtle and is sent down open. When it strikes the bottom a spring catch is released and a specimen is snapped up in the jaws.

Perhaps the most fascinating study connected with the sea is the multitudinous life found in all oceanic waters from the surface down to the deepest abyss yet explored. Physical and chemical changes in the ocean waters have profound influences upon marine life, its variety its amount and its distribution. A knowledge of these influences will contribute in many ways not only to the study of evolutionary processes taking place in the sea, but also to the practical problem of economic use of the ocean's food supply. The problems in marine biology are so many and so far-reaching that it has been necessary to confine our attention chiefly to microbiology, to determine the abundance and distribution of the so-called "grass of the sea," the plankton, and other small organisms such as diatoms, copepods, and foraminifera, which ultimately constitute the food supply of fishes and so for our own Friday dinner tables.

Silk tow-nets of various sizes, dip-nets, and water-bottles will be used to collect these organisms. A special double boat boom, called by Beebe a boom walk or glorified pirates' plank, has been rigged so that we can walk out over the water thirty feet from the ship's side, perhaps with more faith than did Peter of old, and there we may dip up surface swimming organisms or operate the surface nets, well away from the disturbing influences of the ship and its motion through the water. A diving helmet is a part of our equipment, so that in warm, clear, tropical waters we may descend thirty to fifty feet below the surface among the fishes, learn how they live, and study and describe the wonders of the under-water world.

Meteorological Problems.

A more extensive programme of investigation in meteorology is being planned, in view of the important influence upon climate of mass movements of large bodies of heat-bearing oceanic waters. The study of the physical interchange of heat and moisture between the surface of the ocean and the air above it is important in the study of atmospheric circulation and the disturbances over the entire surface of the earth because of the fairly normal conditions which exist at sea. Variation in the amount of solar radiation received at the earth's surface, and the influence of such variations upon world-wide weather conditions, have been the subject of much study in recent years. It has been thought worth while to include such observations in our meteorological programme, together with observations of cloud systems, rainfall, evaporation, dust-content and carbonic-acid content of the atmosphere. Increased data of these kinds over the great oceanic areas to be covered during this 110,000 mile cruise of the *Carnegie* may be extremely valuable in the comparison of world weather with solar variation, in the determination of the rate at which the atmosphere is being charged with water vapour so vital to life on the continents, and in the study of the dynamics of atmospheric circulation over the oceans.

Native Magic and Leprosy in Africa.

By Capt. W. Hichens.

Late of the Native Administrative Service, East Africa.

In discussing the campaign against leprosy in Africa which has followed Sir Leonard Rogers' discovery of a cure, the author shows by what means native magic not only hinders the work but helps to spread the disease.

WITCHCRAFT and superstition loom so large in the daily life of the African savage, that science, in offering the native the benefits of her discoveries, often finds herself repulsed and dismayed by the barriers set up by witch-doctors, and by the apathy and fear behind which the kraalsfolk entrench themselves.

What if the white man holds that the plague in the kraal which wiped out a hundred of the clan was caused by the bite of rat-fleas. "*Magu ish*! Whoever heard of such nonsense! Has not Mgwek, the medicine-man, declared that the plague was the visitation of demons working the evils of black magic for witch-doctor Ndizigwa, his rival? If you doubt that, *mala*, you would doubt everything! For did not Mgwek cast *urogi*, the contra-black-magic of the slow-death, over all the kraalsfolk of Ndizigwa's village, so that they paid in haste a recompense of seventy head of cattle; whereat Mgwek forgave his rival Ndizigwa and the plague of demons passed away, even as Mgwek had said?

"You say the plague took many victims, while Mgwek was seventy cattle richer for his cunning! By all the bones of sun-bleached centipedes! What else would you have? All men know that the demons of the plague seize victims, and why should Mgwek work his great magic for nothing? After all, he stood us kraalsfolk a great meat-dance with two roast oxen from the seventy he earned! As for your white doctor with his talk of rats and fleas—rats and fleas are with us ever; and if his talk were true then the plague would be with us ever; but it is not!"

Such is the logic of the savage, deep ingrained into the superstitious niches of his obscure mind; and to try to controvert it is one of the most soul-wearying tasks which confronts the worker amongst savage peoples. It is an exasperating, mulish, resistant, passive point of view, and is a main obstacle now standing in the path of one of the finest pieces of pioneering work ever undertaken in East Africa—the campaign against leprosy made possible by the cure discovered by Sir Leonard Rogers and effected by injections of a vegetable oil.

A NATIVE DRUM DANCE.

At such functions as the native *ngoma* or drum dance illustrated above, often attended by hundreds of natives and by mothers who take their children with them, lepers are frequently to be met, dancing with their friends.

That leprosy is curable Rogers has proved beyond all doubt, and his claim that a cure can be effected in all early cases and in about twenty per cent of advanced cases marks a triumphant epoch in tropical medical research. There are certainly not less than half a million lepers within the British Empire, victims of a disease which, though far less repulsive and infinitely less contagious than is commonly imagined, is nevertheless a scourge whose rigors are too familiar to need description. In British Africa there are, it has been estimated, over 80,000 lepers; but that figure is unfortunately far below the actual number. It does not, and cannot, take into account many thousands of lepers who live promiscuously amidst their tribesfolk in the kraals of the backveld. In one small tribe numbering about 150,000 natives in a plateau district in Tanganyika, the writer, when administrative officer in charge of the district, accounted for over 400 lepers; but many cases were concealed from him.

In some cases the lepers were not themselves aware that they were afflicted, for in its early stages leprosy is not always evident to a lay diagnosis. In the majority of cases natives evinced the strongest aversion

to admitting themselves lepers, not because of the ostracism which might be inevitable in the case of a sufferer in a white country, but because they dreaded the prospect of being segregated in isolation camps, away from their wives, children, and relatives, and the amenities of the kraals. In a vast majority of cases dread of witch-doctors prevented sufferers, their relatives and neighbours, and even chiefs and headmen, from disclosing the carefully guarded secret of their affliction. The *arogi* or witch-doctors of this native district, in common with the witch-doctors of many other savage districts in the backblocks of Africa, claimed to be able to afflict any man or woman with the dreaded *nambu*, as they term leprosy, by the machinations of black-magic; and in the eyes of the tribesfolk a leper was one bewitched with this terrible magic. In such terror is this form of black-magic held by the kraalspeople that even the fearful word *nambu* is not spoken by them, the word *matana* (*i.e.*, the "illness") being used in its stead. No tribesman willingly gives information to identify a leper, lest the witch-doctor who worked leper-magic on the sufferer should in vengeance wreak an even more frightful spell upon the informant. The leper himself, confidently believing that he has been bewitched and probably being conscious that some neighbour or relative or enemy had good grounds for working off revenge on him, seeks out a friendly witch-doctor of his own clan. He then pays fees in goats, grain, fowls, beads, axes, and other native money, for a spell of counter-magic which will cure his affliction and at the same time inflict some terrible suffering upon the enemy by whom he has been bewitched.

A Domestic Quarrel.

A typical instance of this magic is provided by a case which came before the writer as a magistrate in a native criminal court in Tanganyika. A youth, one Mkulu bin Pundi, complained that his uncle Nzuri bin Maugila, a wealthy native known to the kraals as a dabbler in black-magic, had unjustly bewitched him with *nambu* with the result that Mkulu developed leprosy in the left knee.

Said Mkulu, "During the famine, when food was scarce, I asked my uncle for permission to work for him by herding his cattle and tending his plantations, my wages to be my food and lodging. I lived with my uncle for a year, and food was then so scarce that my uncle decided to bury his remaining grain supplies in a pit as a precaution against thieves. I went with the young men and the women of his huts and we buried the grain in a pit in the bush. Two days later he drove me from his house because I was too tired to clean out his cow-yard. I had nothing to to eat; there was famine; so I went to the place where we had buried the grain and took some to my hut, where I cooked it and buried the rest in a pit near my hut. In the evening of that day my uncle came to my house and accused me of stealing his grain. I said, 'Yes, I have taken it, but you drove me away, and I had no food, so I took it to eat.'

"On the following day we went before our chief who heard my uncle's charge, and the chief fined me one cow and three goats for theft. I took this fine to my uncle, but he refused to accept it and he said, 'Since you stole my grain in famine time I will destroy you with disease. I am a rich man and do not want your cow and goats; I will destroy your body with disease!' Later a sore appeared on my left leg, and that developed into leprosy. When I went to pay him the cow, I saw one of his women, Mguli, take earth from my footprints to mix with *nambu-dawa*, leprosy-magic-medicine, which is the way of our tribe to give thieves leprosy."

The Witch-doctor's Methods.

After numerous native witnesses had testified that Mkulu had not shown signs of leprosy before he went to work for his uncle, or before the theft of the grain, the chief of the kraals concerned, under careful cross-examination, divulged with much hesitation the method in which this dreaded magic is worked, and his account, as follows, is quoted from the court file. "I went to a place near Mkulu's hut; there was a pit there, such as is dug for burying grain. The pit was filled with loose earth. I ordered Mkulu to remove the earth. He did so, and disclosed, first, a branch of a thorn bush; under this, a short stick sharpened to a point and standing upright on a stone; under which stone was another short stick. These things are used by the witch-doctors to work *nambu*, to give people leprosy. I did not touch the things. I would not touch them even if the court ordered me to do so; I would prefer imprisonment."

It would be silly, the chief went on to explain, for anyone to think that a mere sharpened stick could give a man leprosy; but, he said, the stick which had stood point upwards on the stone was cut by a witch-doctor from the doorpoles of a leper's house. It would be infectious from continual contact with the leper's hands. And it was so placed on the stone, that a man standing by or kneeling near the grainhole could scarce help but tread or kneel upon its sharp point concealed just beneath the surface of the earth, so that the stick would pierce his foot or

knee and innoculate him, as it were, with *nambu*. The stick under the stone was *urogi* (magic), which the chief did not understand, or would not explain. It was apparently symbolical of *nambu*, for it was of rotten wood, cut from a tree eaten away by white ants, by small white worms or maggots. The stone and the sticks taken from the pit were brought by Mkulu into court. None of the native court officials or orderlies would touch them, and several hundred kraalsfolk who had assembled to hear the unusual case gave these gruesome exhibits a very wide berth.

Far from denying the charge made against him, Mkulu's uncle both admitted and defended it. "I told Mkulu that I would work *nambu*-magic on him," he said, "and the *nambu* sticks now being shown in this court were set in his grainpit on my instructions. For a youth such as Mkulu, who stole food in famine time, what punishment is too great? In the hands of such thieves, I and my wives and children might well have starved to death!"

As emphasizing the implicit faith of the savage in the powers of black-magic to cause leprosy, and the complacence with which the savage leper accepts his fate, it must not be overlooked that Mkulu in bringing his case sought to extract from his uncle a fine in cows and goats for *unjustly* putting leper-magic on him. He was an admitted food-thief, and for that the chief had fined him a cow and goats which his uncle refused to accept. That refusal irked Mkulu. He regarded leprosy as a minor detail, but being bewitched with it by a relative who ought to have accepted a fine, was an affront. When the writer offered to send Mkulu to hospital with a view to being cured, the youth refused to go. "No," he said, "my uncle should pay me a fine in cows and goats; if he does, I want to stay in my kraal and herd them. With two of the goats' kids I can easily pay another witch-doctor to *toa nambu*, to 'unbewitch' me of my leprosy."

TYPICAL NATIVE LEPERS.
A headman of a kraal (left), with his register, produces two lepers. The peculiar expression of the man on the right is typical of the disease.

GROUP OF WITCH-DOCTORS.
These witch-doctors (seated) are notorious throughout Tanganyika for the malevolent power which they claim of being able to bewitch people with leprosy.

Under different names similar forms of black-magic are rife amongst other savage tribes in East Africa. In one tribe, medicine-men are said to inflict leprosy by smearing with leper mucous thorns growing on a springy kind of sapling. The smeared sapling is tied back, alongside the path to the victim's hut, and a tripline made of cows' hair is so set on the ground that the victim's foot springs the trap; and the sapling swinging across the path catches the man across the chest or back, the thorns slashing his skin. Curious sharp three-pronged thorns are also used, being scattered in the doorway of the victim's hut so that they pierce his toes; while in yet another tribe witch-doctors have been known to creep into their victims' huts at night, while they were sleeping, and smear their lips and other parts of their bodies with a paste in which various *dawas* or magic-medicines obtained from lepers were mixed.

Amongst many tribes it is implicitly believed that the mere touch of a witch-doctor, such as resting his hand on his victim's arm or shoulder, or flicking him with a thumb-nail across the chest or stomach, can inflict leprosy. A leper himself may be paid a fee of goats and be given "magic" power by a witch-doctor to carry out the magic spell.

Thus it comes about that the thousands of lepers living freely in the kraals of Africa's backblocks are regarded as victims of black-magic, and are treated rather with pity and sympathy than with apprehension. There can be scarcely a native kraal in the hinterland of East Africa to-day where lepers are not mingling with the healthy kraalsfolk—sitting with them around and eating out of the same cooking pots; drawing their water and drinking at the same wells and water holes; joining shoulder to shoulder with them in their dances; sitting with them in the crowds at their native bazaars or courts and tribal gatherings, and intermarrying with their healthy kinsfolk. It is common to find a male leper married to a healthy native girl, or to see a leper mother nursing her child, a jolly laughing piccaninny, whose glossy brown skin, satin-like and flawless, testifies to its freedom from the scourge.

On its neck or its wrist the child will wear an *irizi*, a talisman bought from a witch-doctor, and with that protection from black-magic, the evil-eye, and other forms of bedevilment, its stricken mother is unwaveringly confident that the child cannot fall victim to the dreaded *nambu*, unless by ill-fate some evil-intentioned person, with a more potent charm, overcomes the power of the *irizi* and bewitches the child. The witch-doctors who practice *nambu*-magic naturally bolster their tribesfolks' faith in its terrors, for they derive a rich harvest from it, in fees of goats, grain and other commodities. In addition, the more people they "bewitch" with leprosy the greater the notoriety they achieve and the stronger the hold they gain upon their credulous and fearbound tribesmen. In the face of such beliefs, it will readily be seen how difficult it is to persuade native lepers to submit to treatment and to the inconveniences of segregation.

Leper Camps.

With the funds for the entire anti-leprosy campaign throughout Africa amounting to less than many spendthrift borough councils in England are frittering away in doles, it is impossible for private enterprise to provide either adequate medical or nursing staff or to build suitable *lazarettos* and hospitals for the lepers of the backveld.

The best backveld leper camp can only hope to be a cluster of mud-walled, grass-thatched huts built in the isolation of the bush. To provide adequate guards to prevent lepers deserting such camps, is not yet possible. Wives, children, and relatives visit the camps and often take up permanent residence with their afflicted kin, and, although leprosy is not so contagious as imagined—the writer was an official visitor to a leper camp for many months with no greater precaution than a fly-whisk—the scourge is spread from kraal to kraal, unchecked.

The difficulties which must be surmounted by the medical pioneers who are working amongst these savage peoples can be imagined. There are, as Sir Leonard Rogers has recently announced, sixty-two British men and women doctors administering his cure in British Africa, and during the past few months 100,000 doses of the cure have been sent out. It is aimed to increase the number of stations at which the cure can be distributed, and also to plant hydnocarpus trees, from which the curative oil is derived, in districts where leprosy prevails. So is marked a new epoch in British efforts to ameliorate the lot of the suffering thousands who are victims of what the savage looks upon as the black-magic of *nambu*—that terrible scourge, nigh as baleful as the native superstitions which surround it, and which can be conquered, not by gun or rhino-whip, but only by that greater magic, the untiring zeal of the white pioneer.

The Home University Library.

EVERYONE will be gratified that the Home University Library has been given a new lease of life, and the first volumes to be added since Messrs. Thornton Butterworth took over the series in every way maintain the former standards. New titles are to be issued yearly, and recent additions to the science section include "Sunshine and Health," by Dr. Ronald Macfie; "Birds," by Dr. Landsborough Thomson; and "Insects," by Professor Balfour Browne.

Among the new literary titles, Mr. J. R. M. Butler's "History of England 1815-1918" is of outstanding interest. The hundred years between the Great War which we all remember, and the last great war before it, must always rank among the cardinal periods of English history, for it changed the face and outlook of England as no previous century had changed them. Besides the industrial revolution and the birth of modern science, Mr. Butler reminds us of a factor of no less significance, which is not always given its true value. The religious revival connected with the names of Wesley and Whitefield was less spectacular than the economic and political movements, but it was an impulse which gave a new source of thought and action to many thousands of men and women, enabling them to endure without despair the hardships of an age of transition. At the present time, when intellectual thought is again passing through a state of flux following another war, it is well to be reminded of a great moral force which sustained our forefathers in a similar period.

Among the Stars: A Monthly Commentary.

By A. C. D. Crommelin, D.Sc., F.R.A.S.

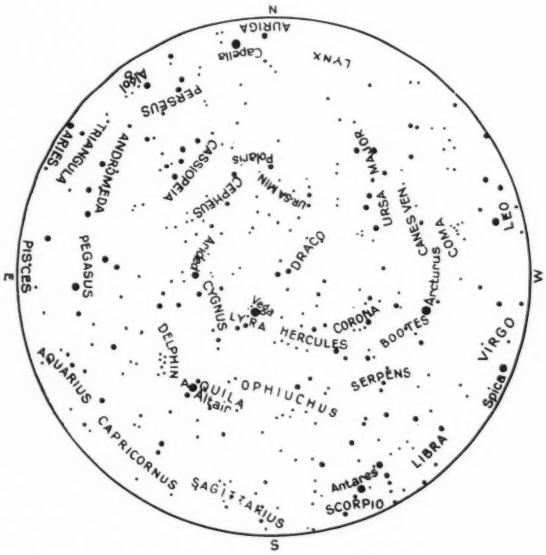
Nova Pictoris.

Dr. Spencer Jones, His Majesty's Astronomer at the Cape, is now in England, and gave the latest information about Nova Pictoris at the June meeting of the R.A.S. It is now thought that the large rings, some 3 minutes in diameter, round the star are not real, but arise from the star's colour being red, so that its image is somewhat out of focus; similar rings have been seen round other red stars on photographs. The much smaller oval nebulous patch, some 1½ seconds in diameter, round the star is real; it contains four condensations, whose positions may be described as follows. Draw an inverted equilateral triangle; the brightest condensation is at its centre of gravity, the faintest at its lower angular point, while the other two are slightly below the upper angular points. The faintest one was a very difficult object, only rarely seen, but the others were not difficult. The further development of these condensations will be very interesting. Fortunately the star, being a long way from the path of the sun, can be seen at some time of the night throughout the year, so the watch on it can be continuous.

Planetary Photography.

Prof. W. H. Wright delivered the "George Darwin" lecture at the R.A.S. last month, choosing planetary photography as his subject. His photographs of Mars with infra-red light show the surface markings very strongly, while those in ultra-violet light hardly show them at all, but show patches of cloud or mist in the upper regions of the planet's atmosphere. Similarly, terrestrial photographs of distant landscapes in red light show detail, while those in violet light are veiled by a general mist. The familiar fact that the setting sun looks red arises from a similar cause; the shorter wave-lengths cannot penetrate a thick layer of air. The conclusion as regards Mars is that it, like the earth, must have an atmosphere of appreciable density and considerable absorptive power. This fact, combined with the radiometric measures of Lampland, Coblentz, and others, which indicate a summer temperature of the planet's surface far above freezing point, are in favour of its possible habitability. In fact, most Martian observers consider that the changes of tint of the bluish-green regions can best be explained by the seasonal changes of some kind of vegetation; and where there is vegetable life it appears likely that it is accompanied by at least low forms of animal life.

The photographs of Venus, unlike those of Mars, showed no detail at all on the infra-red plates, but did show some markings on the ultra-violet ones. These markings must be in the upper regions of the planet's atmosphere, and there seems to be some hope that repeated photographs of the kind may help to solve the problem of the planet's rotation; the solid body, however, might be rotating at a different rate from the upper regions of the atmosphere. The absence of detail from the infra-red pictures may mean either that these only reach a lower cloud layer, or, if they reach the actual surface, that it is uniform throughout, for example, a water surface.



The Heavens as seen from London at 18 h. sidereal, that is, at 11 p.m. (12 p.m. summer time), on 7th July, and 10 p.m. (11 p.m. summer time), on 21st July. Saturn is now well placed for observation, a few degrees high left of Antares.

Scope for the Cinema.

The photographs of Jupiter in ultra-violet light are distinctly larger than those in infra-red, showing that they portray a higher region in the atmosphere. But in the main the system of belts appears the same in both sets of photographs, showing that the belts extend to a great depth. Prof. Wright exhibited a very interesting series of cinematograph pictures of Jupiter; these were taken at intervals of a few minutes, but were run through the lantern at a more rapid rate, so that one saw the planet rotating and could observe its whole surface in a short time. A satellite crossed the disc during the exposures, appearing bright near the edge of the disc, and dark near the centre; its shadow was dark throughout. These photographs clearly showed that the cinematograph has many possibilities in astronomy, not merely for popular exposition but also for research.

The International Astronomical Union.

The third triennial meeting of this body will be held this month at Leiden, and will be attended by astronomers of almost every country. The aim of the meetings is to co-ordinate work and prevent unnecessary overlapping. The best methods of attacking problems are discussed, and observers have fields of work suggested to them. The Union has already been of help in accelerating the publication of the remaining zones of the great photographic star catalogue, and the end of this work—it was begun about forty years ago—is at last in sight. Plans are being drawn up for making the utmost use of the near approach of Eros to the earth in January, 1931, to study the size, shape, and colour of the planet, in addition to its parallax.

One of the sections of the Union, that of meteors, is specially suited for amateurs, since no instruments are needed, though cameras with rapid lenses are very useful for active showers; Prof. Lindemann and Mr. Dobson have obtained valuable information about the upper air by a photographic study of meteor trails.

Book Reviews.

The Conquest of Mexico. By BERNAL DIAZ DE CASTILLO, 1517-1521. Edited and translated from the Spanish by PROFESSOR A. P. MAUDSLAY. (Routledge. 15*s*.).

The Silver Cities of the Yucatan have exercised upon archaeologists and others a fascination which has not dimmed in the four hundred years which have succeeded the Conquest of Mexico by Cortés. And Bernal Diaz's account of the exploits of the Conquistadors, here admirably reproduced and edited in the Broadway Travellers' Series, goes far to tell us why. Professor A. P. Maudslay, moreover, who is Professor of Archaeology at the National Museum, Mexico, is not only fortunate in his publishers for, for the purposes of making his translation he has had access to the exact and only complete copy of the original Diaz manuscript which has never left Guatemala, and which is now preserved in the Guatemalan archives. This is far from saying that his task has been an easy one. Whatever else Cortés's faithful lieutenant may have been, except when moved, he was no born writer, and it is therefore all the more to his translator's credit that we are not reminded more often that we are of our school-days—our Anabasis—and that wearisome reiteration of so many *parasangs* per day.

But putting narrative skill on one side, what an absorbing story this bluff old warrior gives! Young and impecunious at the time of the events which he narrates, he himself was frankly after fame and fortune, yet very soon, as he is honest enough to record, he was wondering how far the game was worth the candle. "So great was our thirst that our mouths and tongues were cracked with dryness and there was nothing to give us relief. Oh! What hardships one endures in discovering new lands in the way we set out to do it; no one can appreciate the excessive hardships who has not passed through them as we did." A hazardous business, it seems, this plunging of a mere handful of Spaniards into the unknown against a powerful and warlike race, and yet one which he felt, on the other hand, held its compensatory rewards. For, apart from material gain—though nothing is more to the discredit of Cortés than the way he cheated the common soldiers of treasure trove—fair Indians became fair game; "to every man a damsel or two" the order of the day. And with delicious irony they had all, first of all, to be baptized! Christianity and Conquest were at all times to go hand in hand.

It is in this story of religious zeal and fanaticism, and in his descriptions of the Maya gruesome heathen rites, that Diaz is at his best. Cortés has often been accused of being cruel on enforcing Christianity upon his conquered foes, and in employing such methods as he did, but his cruelty pales beside the orgy of human sacrifice which existed in its place. To Cortés, like Cromwell, not only was the smashing of idols but in accordance with the will of God but, unlike Cromwell, the Spaniards had always before them the awful fate which awaited any of their comrades who might fall into the enemy's hands. Here is one such occasion which the author gives us to understand he witnessed from a distance: "When they got them up to a small square in front of the oratory, where their accused idols are kept, we saw them place plumes on the heads of many of them and with things like fans in their hands they forced them to dance before Huichibobos, and after they had danced they immediately placed them on their backs on some rather narrow stones which had been prepared as places for sacrifice, and with stone knives they sawed open their chests, and drew out their palpitating hearts and offered them to the idols that were there, and they kicked the bodies down the steps, and the Indian butchers who were waiting below cut off the arms and feet and flayed the skin off the faces, and prepared it afterwards like glove leather with the beards on, and kept those for the festivals when they celebrated drunken orgies, and the flesh they ate in ***chimole***."

That the hand of God was with them is, indeed, quaintly expressed throughout. On one of the many occasions when Bernal was wounded he tells us about it like this: "Many Indians had already laid hold of me, but I managed to get my arm free and our Lord Jesus Christ gave me strength so that by some good sword thrusts I saved myself, but I was badly wounded in one arm." The concluding stages of the siege of Mexico City—a siege which lasted eighty-five days, and which involved the most stoic courage and endurance on the part of the defenders—are thus described: "Guatemoc and his captains were captured on the thirteenth day of August at the time of vespers on the day of Señor San Hipolito, in the year one thousand five hundred and twenty-one, thanks to our Lord Jesus Christ and our Lady the Virgin Santa Maria, His Blessed Mother, Amen." It must all have been so very satisfactory. Complacent, never; but perhaps we cannot wonder if consistent Divine approval makes our author here and there seem at times a little vain.

H. A. J. WILDER.

Biological Chemistry and Physics of Sea Water. By H. W. HARVEY. (Cambridge University Press. 10*s*. 6*d*.).

An Introduction to Oceanography. By J. JOHNSTONE. Second Edition. (The University Press of Liverpool Ltd. 15*s*.).

During the last twenty-five years the science of oceanography has progressed enormously, and includes so much that a general textbook is practically an impossibility. These two volumes are therefore specially welcome, dealing as they do with two quite different aspects of the subject. That one of them has already reached a second edition is ample proof that such books are wanted.

Mr. H. W. Harvey's "Biological Chemistry and Physics of Sea Water" treats of a still more modern side of physical oceanography where there was an obvious need for a work which should bring together all the valuable information, so much scattered, which existed on the subject. Mr. Harvey has accomplished his task with conspicuous success, and all his work tends to show the relationship of the chemistry and physics of the sea to the living creatures in it and the importance of studying the life in the sea in relation to its environment. His sympathy with "all those cold-blooded animals who live in the sea," to whom he dedicates his book, is very apparent, and marine biologists and physiologists will be grateful for much help. Already both botanists and zoologists are paying more and more attention to the chemical and physical factors which affect all marine organisms, and here they are aided in every way possible. All fisheries questions have, of course, to do fundamentally with a minute knowledge of the sea—chemistry, water movements, temperature, etc., and the biologist as he progresses in the solving of his fisheries problems finds himself more and more dependent on the hydrographer. The present volume has ever these problems in view, and based as it is on the newest methods, much of which originated from the author's own work, or from that of other workers at the Plymouth Marine

Biological Laboratory, it is, and will be for some time, the standard book on the subject.

Professor Johnstone, treating his subject from an entirely different standpoint, deals chiefly with the geographical and the geophysical aspect. As he himself says, it is with the outlook of the student of geography and geology that the book has been written. He has improved it very much, having rewritten a large part of it, and although he includes chapters on the chemical and physical characters of sea water, the greater part is occupied with discussions on the origin of the earth and its oceans, the character of the sea bottom and the coasts, the tides and the oceanic circulation. Some prominence is now given to the influence of radio-active substances in the earth's crust with reference to its age. With regard to the permanence of ocean beds the view is taken that there is no satisfactory evidence in favour of their elevation to form new continental land regions, but that there is evidence that former continental lands have undergone depression and are now deep ocean beds. The statement on page 338 that "wherever there are now sedimentary rocks there must have been sea in the past" is rather sweeping. Are we not to take into consideration any fresh water deposits? The whole question of secular changes in the ocean dealt with in the last chapter is extremely interesting, the following conclusions being emphasized: "Great land areas have probably disappeared and been replaced by ocean," but "there is no good evidence that ocean floors have ever become dry land" and "It is highly probable that the volume of the ocean has increased throughout geological time."

Possessed of these two books, the student will have a very good idea of most of the questions involved in modern oceanography, and will almost certainly be stimulated to continue investigations in one or more of its branches.

M. V. Lebour.

Propaganda Technique in the Great War. By Harold D. Lasswell. (Kegan Paul. 10*s.* 6*d.*)

For good or for ill propaganda obviously plays a most important part in modern life. It is popularly supposed to be somewhere near the basis of the greatest commercial successes, and both in war and in peace it exercises a profound influence upon the course of international relationships. As everybody knows, during the late war the organization of propaganda was developed to the extent of becoming an enormous practical art. Every important belligerent nation made use of this weapon, and was more or less convinced of its efficacy. Consequently Dr. Lasswell's study, which is the first comprehensive, detailed, and critical treatment of war propaganda based upon the records of 1914-1918 to appear, is to be warmly welcomed.

Propaganda is defined by Professor Lasswell as the control of public opinion by significant symbols, that is, by stories, reports, rumours, and other forms of social communication. He shows in detail, and with abundant illustration, that its use is conditioned by: traditional prejudice, the network of communication between the peoples concerned, and the general state of irritability or unrest characterizing the community (he calls this the "tension level of the group"). He describes the actual methods of propaganda organization adopted during the war by England, America, France and Germany, suggesting in a most interesting way that the differences of method connect up with important racial and national differences. He treats the aims of propaganda as four in number: to mobilize hatred against the enemy, to preserve the friendship of allies, to influence neutrals, and to demoralize the enemy. He recounts the varying methods adopted to bring home these aims to different sections of a population, making some particularly apposite remarks about the relation of propaganda to truth. Finally, he briefly assesses the results of propaganda, which he believes in this instance to have been very considerable.

The whole book is extremely interesting and worth reading. That it is not written from a psychological point of view is probably all the better. We get facts rather than theories. Yet in some respects the author might with advantage get a bit nearer inside the minds and attitudes of the propagandist, official and unofficial. There is a too strongly developed tendency to regard him as the clever wire-puller, jerking about the puppet members of the ordinary social group, but knowing all the time that he is really at play. It is difficult now to realize the honesty with which nearly all the stories which Dr. Lasswell records were developed and passed from mouth to mouth during the war. But the fact was so, and both propagandist and his audience were the outcome of a social situation which they, in their turn, shaped to new ends.

A very useful bibliography is included in this book.

F. C. Bartlett.

The Basis of Sensation. By E. D. Adrian, M.D., F.R.S., Fellow of Trinity College, Cambridge. (Christopher's. 7*s.* 6*d.*).

The events which occur when an external object gives rise to a sensation consist of a number of different processes. We need not consider whether there is really such a thing as an external object, but we assume that there is some external cause for the sensation. All our attempts to analyse the processes are again reduced to a series of sensations, and it is on such a basis we build up our ideas of a physical universe.

As the result of such analysis we are lead to the view that all sensations, which are not hallucinations, are related to impulses which travel up sensory nerve fibres. Dr. Adrian's book is concerned with some aspects of the production and conduction of these nerve impulses. Associated with the passage of a nerve impulse is a change of electrical potential on the surface of the nerve. By means of three-electrode thermionic valves it is possible to amplify the electrical changes to such an extent that the impulses from a single nerve fibre can be recorded and analysed.

One outstanding feature of the processes of sensory reception is that although sensation may be continuous the nerve impulses are discontinuous, in other words, the nervous system is bombarded by a series of discrete impulses. This must be so because after one impulse has passed along a nerve, the nerve enters into a refractory phase during which it is impossible, by any experimental means known up to the present time, to cause another impulse to travel along the nerve.

A second peculiarity is that no one has been able to demonstrate any difference in the impulses no matter what nerve is excited to action. For instance, the electrical and other activities of the nerve is the same whether the resultant sensation is one of sight or of taste (Muller's Law). Thus we are led to believe that the quality of a sensation is anatomical depending on the course of the conducting paths to the central nervous system.

If the above conclusions are correct, the only difference between one stimulation and another will be in the number of impulses passing to the nervous system in a given interval of time. The number of impulses is related to the physical intensity of the stimulus, hence the magnitude of the sensation

is related to the number of impulses per second reaching that part of the nervous system which interprets the sensation.

For those who wish to have a simple and readable account of this view of nervous activity Dr. Adrian's book gives a clear statement of the arguments, based mainly on his own researches on the nervous impulses resulting from stimulation of such nerve endings as those in muscles, skin, and eye.

H. E. ROAF.

History and Historical Research. By C. G. CRUMP. (Routledge. 5*s*.).

Of late years there has been a tendency for the term "research" to fall into disrepute, largely owing to the fact that much of the so-called research work has been done solely for the production of theses for higher university degrees rather than for its own sake. The author of this stimulating book plainly shows that he has little sympathy with the kind of research suggested by the professor to the student at a loss for a subject. If historical or scientific research is to be made a living thing, it is indispensable, as the author points out, that a student must let his subject take possession of him and not remain in leading strings.

After a short discussion on the type of mind required for genuine research, the book deals with the discovery of a subject, the search for materials, the making of notes, and the final presentation of the results. In every chapter there are to be found valuable hints and sound advice given in the form of fitting aphorisms. For instance, referring to the temptation of the student to bow down to the authorities of a great name, the author remarks that "the scholarly author can hide his ignorances from himself and from his reader so cunningly that neither shall ever discover them." In other words, the student should not take anything for granted, but should always verify the statements on which he bases his conclusions.

Everyone interested in the study of history should read this book, for its broad scholarly outlook extends far beyond the limits of practical research work.

C. AINSWORTH MITCHELL.

The Human Habitat. By ELLSWORTH HUNTINGDON. (Chapman & Hall. 15*s*.).

The remark of a foreign visitor to this country, that England had no climate, but had bad weather, seems to be less depressing after a perusal of this book. For in it we are told that the frequent abrupt changes of weather so characteristic of Western Europe are directly responsible for western civilization. This idea is the main theme of the book, and throughout the volume we hear, time after time, that the climate of any portion of the globe is responsible for the degree of civilization found in that area.

The method employed in the development of the theme is direct and characteristic of an American author. We are introduced to the methods of life of the peoples who inhabit "lands that are too cool," lands "too warm and moist" and, in brief, to the peoples of the whole world. Whether climate is indeed as important in the forming of the habits of a people as the author would have us believe, is a point for discussion, but it would certainly be more scientific to refer any influence which climate may have had to the causes of climate rather than to climate itself. Once the habits of a people are established, natural selection, aided by the inheritance of acquired characteristics, solves all problems according to the author. It seems fairly obvious, however, that many other factors come into play in the development of a civilization, else why did our present civlization arise in Western Europe, rather than in the equally favourable New England states? Of course, climate must have played no small part in the earliest civilizations, but many more influences seem to have been at work.

In colonization again climate is not as all-important as the author believes. The idea that the climate of lands which once supported great civilizations has changed since their period of power, seems to be supported by the evidence deduced from the study of the giant sequoias, which, according to recent correlation with Old World records, afford information as to the variations of the climate of the whole globe. Since colonization of unfavourable lands must undoubtedly occur, if the population of the world increases at the present rate, it behoves all civilized nations to support research institutions in these climates, with the idea of discovering remedies or palliatives. Although not mentioned in the book, this conclusion forces itself on the reader. Strange as it may seem, Great Britain is the least well-equipped of all nations in this respect.

J. E. HALLIDAY.

An Investigation of a Rotating Radio Beacon. (H.M. Stationery Office. 2*s*. 3*d*.).

This report describes experiments carried out by the Department of Scientific and Industrial Research on a radio beacon transmitter, the aerial system of which consisted of a rotating loop or frame coil. After an initial calibration of the beacon a series of tests was made in various ships under actual sea-going conditions, in order to establish the reliability of this system of radio direction finding as an aid to marine navigation. The accuracy of the wireless bearings obtained from the beacon was measured at various distances, and the range of the beacon for reliable working ascertained. The night errors encountered at the longer distances were studied in more detail at various fixed positions, chosen to show the effect of transmission over sea and land respectively.

As a result of these experiments it is proved that the rotating loop beacon can give reliable bearings of the same order of accuracy, and at similar ranges as those obtainable with other systems of wireless direction finding, under the most favourable conditions. A great advantage possessed by the rotating beacon system is that it requires only an ordinary wireless receiver and a suitable watch to enable a ship to take bearings and that the method overcomes certain disadvantages met with when using direction finders on board ship, particularly in the case of small ships. It is, therefore, likely that this system will prove of considerable value in the application of wireless to marine navigation.

Chemical Encyclopaedia. By C. T. KINGZETT, F.I.C., F.C.S. Fourth Edition, 1928. (Balliere, Tindall & Cox. 35*s*.).

The new edition of this encyclopaedia will be welcomed by all interested in chemical studies, as well as by general readers who require to make references. It has been considerably enlarged, containing some 200 pages more than the previous edition. The information, without extending into long articles, is usually full enough to give a good idea of the subject, and care seems to have been taken to bring it as nearly as possible up to date. As a test, the reviewer has looked up a number of recent trade names, such as "Prodorite," "Monax," etc., and has found every one he could think of included. Mr. Kingzett, who began this important work during the war years, has done a service by which his name will long be remembered.